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January **NATURAL HISTORY** *1949*

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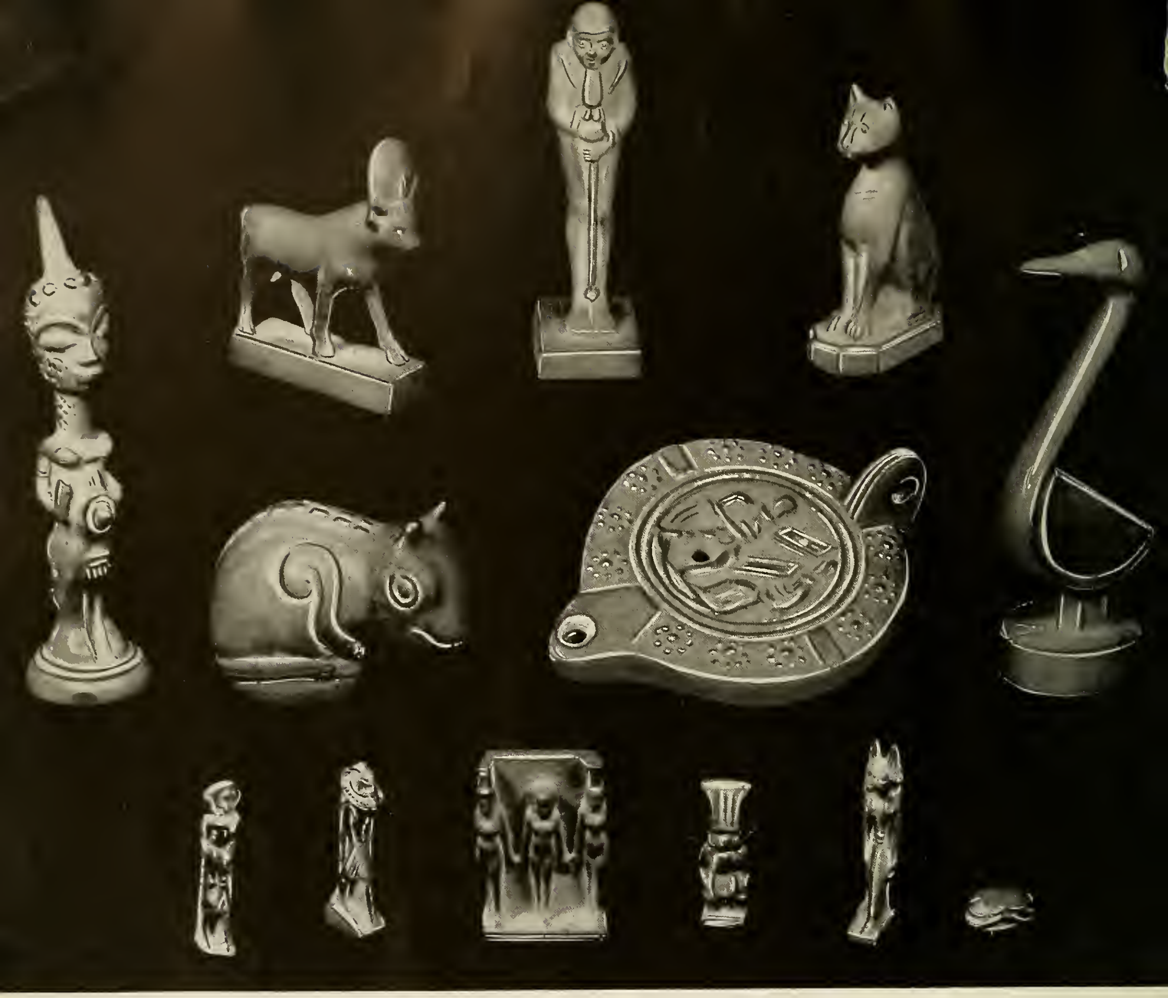
Toad Ally · Ramie—"Wonder Fiber" · Desert Termites



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LETTERS

Thread-waisted Wasp

SIRS:

The performance of an insect that my sister and I witnessed might be of some interest. We were sitting on a sandy bank of a river when a black-and-red insect like a wasp, about an inch long and very thin, came up beside me carrying a grub or caterpillar at least an inch and three-quarters long and as thick as a pencil. The insect carried it under its body in the way the lumber trucks pick up loads of planks (perhaps that is where the inventor got his idea). The wasp also seemed to be a combination pile driver, sand blaster, and excavator. It dug a deep, slim hole in no time at all, scratching it out at first and then, when the hole got too deep for that, carrying large quantities of sand out in its mouth and depositing it six inches away.

It dragged the grub into the hole end-first and after a few minutes came out and started filling the hole. At first, it took the sand down in its mouth, and this is where the pile-driving performance came in. After every few loads, it stood on its head and banged the sand down with the top of its rather large, flat head. This went on until the hole was level. Then it went off six inches and sprayed the sand with perfect aim on top of the hole. It finished the job with a few bits of gravel and tiny sticks, and flew away.

We take NATURAL HISTORY Magazine and would like to know if this was done for food storage or whether the wasp laid its eggs in the grub.

MRS. J. R. ELLIS.

Glendale, Calif.

The following comments are offered by Mr. Herbert F. Schwarz of the American Museum's Department of Insects and Spiders:

Such phrases in Mrs. Ellis's account as "a black-and-red insect like a wasp, about an inch long and very thin," coupled with the fact that the insect was carrying a caterpillar and deposited its prey in a tunnel it had dug in sandy soil, suggest that it was one of the thread-waisted wasps of the genus *Sphex.* The act that Mrs. Ellis and her sister witnessed is performed in the interest not of the industrious adult wasp herself but of her future offspring. After the tunnel has been drilled and the prey deposited, the mother wasp lays an egg upon her helpless victim, which is paralyzed by her sting, and then entombs both victim and egg. The wasp larva that emerges from the egg proceeds to devour the ample banquet, consisting sometimes of more than one caterpillar. It attains its full growth, pupates *in situ,* and finally emerges a winged adult to glimpse the world of sunshine after a childhood and adolescence spent in the darkness of the earth.

▲ FEEDING JAY: An intimate study of a bird that does much to liven the autumn woods and may be seen in midwinter in any part of its range. Photograph by F. E. BRICKEL

Mrs. Ellis speaks of the insect as forcing "the sand down with the top of its rather large, flat head" and also alludes to the insect as a "pile driver." More remarkable still is the fact that certain members of the genus *Sphex* have been observed actually holding a small pebble or a bit of wood between the mandibles and using it to pound the filled-in orifice of the tunnel until the spot is "as hard and firm as the surrounding surface," to use the phraseology of the Peckhams, who were among the first to observe this phenomenon. Here is a true use of a tool, the employment of something extraneous to aid in achieving a given end.

One student of insect behavior has pronounced the act "highly individualistic," but the mounting number of similar instances that have been observed would lead one to believe that this is one of the steps in a behavior sequence shared by at least seven species of *Sphex.* Twenty-five years ago, William Morton Wheeler, in his *Social Life Among the Insects,* noted that no less than nine investigators had observed this phenomenon, and a further observation was contributed to *Science* the following year by George C. Wheeler and Esther Hall Wheeler. In 1932, Hicks supplied two additional instances in articles contributed to *The Canadian Entomologist.*

Since this interesting employment of a tool has been observed repeatedly, there is encouragement for those who wish to share the thrill of witnessing it themselves.

Spined Snake

SIRS:

About ten years ago, I was told that in a certain locality in the mountains, about twenty miles west of my home, there were snakes that looked like rattlesnakes but had a sharp spine on the end of the tail instead of a rattle. One of the spines was given me by a Forest Warden. As I have collected nineteen species and subspecies of our local snakes and have never gotten one equipped with a spine, I wanted to visit the above-mentioned place in the hope of catching a new species. Last summer I had the pleasure of spending a day there and was fortunate in finding a fine specimen of a hognose snake (*Heterodon*) about three feet long. Its tail was tipped with a sharp spine

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one-half inch long and quite different from the blunt tails of the many specimens of *H. contortrix* I have examined.

I wanted to send this snake to C. M. Bogert, of your scientific staff, for identification, but unfortunately the snake forced its way like a mole through a burlap bag and escaped. I have one consolation, namely, that several of our party will testify to the fact that the snake was in perfect condition and did have a spine, and it is probably the snake that looked like a rattlesnake.

D. P. LE FEVRE.
Cumberland, Md.

C. M. Bogert, of the American Museum's Department of Amphibians and Reptiles, states:

It would not be normal for even a large hognose snake to have a spine one-half inch long. Exceptionally long spines at the end of the tail rarely develop as the result of an injury but might be expected to occur as a result of rare embryological abnormalities or even from unusual genetic sources.

The fer-de-lance, the bushmaster, and a few other snakes have spines on the end of the tail that exceed in length and prominence those of the average snake, although they are not put to any special use, as far as is known. On the other hand, some burrowers, like the blind snakes of the tropics, have very sharp but short spines that appear to be used as a means of anchoring the hind part of the body.

The mud snake, or "hoop snake" (*Farancia*), which, needless to say, does not perform like a hoop, has a stout, sharp spine with a definite use. Mr. George P. Meade of Louisiana reports that he has observed captive mud snakes feeding on the aquatic salamander known as the "congo eel," a creature nearly a yard long and quite capable of biting effectively in defense. When seized by a congo eel, mud snakes were able to jab at the prospective prey with the tail, inflicting deep scratches that resulted in the "eel's" releasing its grip. When handled, mud snakes frequently maneuver the tail so as to bring the spine into play, pushing it into the skin of the handler, with harmless if somewhat startling effects. The supposedly dangerous nature of the spine, or "horn," has resulted in such local names as "stinging snake" and "horn snake," neither of which is very appropriate. Still they are preferable to "hoop snake" and its erroneous implications.

Beetle Hunt

A 21,000-mile search in the United States and Canada has yielded the largest single collection of Tiger Beetles in history for the American Museum of Natural History. More than 15,000 individual specimens, including 6 entirely new subspecies hitherto unrecognized by scientists, were collected by Dr. Mont A. Cazier, Chairman of the Museum's Department of Insects and Spiders, on his five-month trip.

The Tiger Beetle, *Cicindela*, is important to science because it survives and thrives in every known region in the world, adapting itself in remarkable ways to varied environmental conditions. In color alone, the same species ranges from almost black in the eastern section of the United States, to bright red in Texas and the Midwest, to bright green on the Pacific coast. Dr. Cazier cites this wide variation as an indication of the rapid and basic genetic changes of which the insect is capable.

Most of the Tiger Beetles known in the New York area can be recognized by patterns of stripes which resemble the markings of tigers. It is from these stripes and from its voracious habits that the Tiger Beetle gets its colorful name. It is one of the most pugnacious of the carnivorous insects. It feeds on other animals exclusively and does not feed on any form of plant life.

Two other collecting projects carried out during the summer for the Department yielded approximately 5000 specimens of *Cicindela*, which will furnish additional data for continuing studies and publications on this group of insects.

Dr. Cazier stated that this collection, added to the Museum's previous specimens of Tiger Beetles, will provide the Museum with the world's largest and most comprehensive collection of American *Cicindela*. The Museum's collection now includes a total of more than 70,000 classified specimens.

Uncut Minerals and Jewelry

A novel exhibit has been placed on display at the American Museum of Natural History highlighting a new trend toward the utilization of a host of natural minerals such as beryl, white topaz, and quartz in artistic jewelry.

The exhibit is one of a series of displays emphasizing the beauty of form of uncut crystals and showing that their natural symmetry is frequently more exciting than the stereotyped facets placed upon them by the unimaginative lapidary. The exhibit features jewelry designs by Miss Pearl S. Shecter, Art Director of Elizabeth Irwin High School, "The Little Red School House." Miss Shecter has been a recognized designer of metal forms since 1937 and has studied with some of the world's leading metal designers and silversmiths. The 21 new designs incorporated in the temporary exhibit are all being shown for the first time.

Striking and colorful plastic forms employed in the exhibit have been designed by Gwen Davies, modern abstract painter, while the entire exhibit and the execution of Miss Shecter's designs have been done by Miss Agnes Schleicher.

The exhibit, which is on display in the Morgan Memorial Hall of Minerals and Gems, will remain on display through January.

NATURAL HISTORY

The Magazine of the American Museum of Natural History

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VOLUME LVIII—No. 1
JANUARY, 1949

Bird-of-Paradise Flower...Cover Design
From a Kodachrome by W. H. Hodge

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You will find Natural History Magazine indexed in *Readers' Guide to Periodical Literature* in your library

THE COVER THIS MONTH

The Bird-of-Paradise Flower (*Strelitzia reginae*) is the most colorful of the four species of this South American genus and perhaps of all the exotic Musaceae, the family containing the bananas and heliconias. (Examples of the latter two have already appeared on the cover of Natural History: September, 1946, and March, 1941.) Three bright orange sepals and three deep blue petals (one reduced) arise from the curious green, boat-shaped bract. One or two flowers are usually open at a time; and as they fade they are replaced by new ones from buds inside the bract.

This is one of the relatively few plants (along with bananas and heliconias) whose pollination is effected by birds. In its homeland, honeysuckers are the chief pollinators. Attracted by the nectar and by the small insects likewise lured, the birds land on a special blue "landing platform," and their weight causes the petals to open, allowing pollen to be dusted on feet and breast.

Strelitzia reginae (literally "Strelitzia of the Queen") was named in honor of the wife of England's King George III, a queenly patron of botany, whose maiden name was Mechlinburgh-Strelitz.

W. H. Hodge.

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YOUR NEW BOOKS

HEATHENS • REEF CORALS • BIRDS
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WILD ANIMALS OF THE WORLD

Animal Portraits by Mary Baker,
Text by William Bridges,
Introduction by Roy Chapman Andrews

Garden City Publishing Company, Inc., $4.95

272 pp., 252 illusts.

THERE is a very real desire springing up in the inquiring mind of this modern age for informative facts about wildlife. No longer is it just idle curiosity that prompts the layman to invest in a work on natural history. The past two catastrophic world wars and the subsequent periods of grave unrest have dampened human ardor for personal gain and glory. In search of security, man's emotional sanity is now instinctively drawing him back to the bosom of nature and the cradle that nursed him. The time is now ripe to fortify literature and stimulate the public thirst for natural history with a popular synthesizing of accurate facts portrayed by intellectual experts in this field.

With simple unassuming directness *Wild Animals of the World* brings to the very fireside living representatives of nature from many faraway fields. Not in terms of hard, cold facts but as living creatures bold and courageous in a world where they have been hunted and persecuted since civilized man started on his plunder of this planet.

With a singleness of purpose Mary Baker has succeeded in catching the subtle charm of the wild things in her portraits that give them life, beauty, and character. Obviously no attempt has been made here to represent all the living mammals. Science recognizes approximately 15,000 different kinds, and a review of the entire world fauna would defeat the purpose of this book. There are 252 portraits of animals (100 of them in color), representing two years of devoted application by Mary Baker.

William Bridges is responsible for the animal biographies; they are not and were not intended to be complete in a technical sense, and therein lies one of the virtues of this work. *Wild Animals of the World* virtually is a cross section of mammalian life bringing out the obvious, the strange, and the curious animals and depicting their special and peculiar characteristics.

Open the book at random, and the page will speak for itself. It won't be necessary to explain that both Mary Lee Baker, the artist, and William Bridges, the explorer, are well equipped. Both are enabled by background to portray vividly and accurately the spirit and character of wildlife.

George G. Goodwin.

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THE HEATHENS: Primitive Man and His Religions

------- by William Howells

Doubleday & Company, Inc., $3.75

306 pp., 16 illusts.

HEATHENS, originally, were the dwellers on the heath outside and away from the village, the town, or the monastery. They were uncouth in manners and backward in the arts, and, still unconverted, they practiced the ancient pre-Christian rites. Of these connotations of the word only the religious one has survived to this day in a somewhat more restricted form. In its modern usage, a heathen refers to one who follows religious beliefs distinct from the great religious systems such as Christianity, Judaism, and Mohammedanism. His manners, however, may be polished and his arts displayed with reverence on 57th Street.

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HILLIS L. HOWIE
The Community School
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The heathens of this world run into many millions, and if the most profound convictions of so large a proportion of mankind deserve attention, then a study of their religious behavior and beliefs is of considerable importance. But the religious convictions of heathendom make a more poignant appeal to us than the mere number of their professors. They reveal the basically human response to the mysteries of the unknown and the incomprehensible, the substratum from which the most refined religious expressions of our own civilization have emerged.

The response of primitive man or heathen to the world around him is fundamentally one of fear and awe, and his efforts to propitiate or control the forces he envisages take a variety of forms, all of them of intense fascination. Dr. Howells has covered virtually every category of heathen religious behavior recognized by students of the subject, and he has done so with skill and understanding. As in *Mankind So Far,* he dissects a difficult subject with apparent ease and always gracefully. No one could ask for a better introduction to an absorbing subject.

Harry L. Shapiro.

BRITISH BIRDS

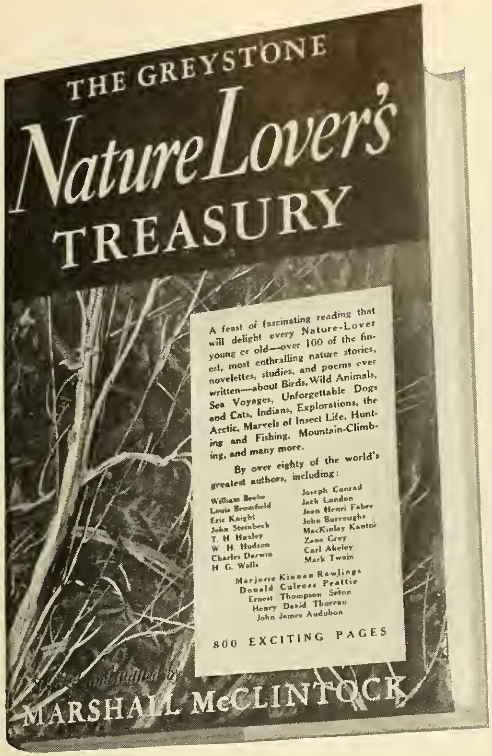
------- by Wilfred Willett

Illustrated by Roland Green

Adam and Charles Black, London
The Macmillan Co., N. Y., $2.50

196 pp., 16 colored plates, 44 drawings

THIS book is a popular account of the better known or commoner British birds. It is intended for visitors to the British Isles or for residents beginning bird study as a hobby. The appearance, seasonal occurrence, food, and nesting habits of some 200 species are described in more or less detail. The author is familiar with his subject, and very few errors are evident. Some omissions are puzzling. The black redstart, for example, is said to be a winter visitant, and there is no mention of its recent remarkable appearance in British cities as a nesting bird among bomb ruins. The absence of scientific names is perhaps not a disadvantage in a work of this nature, but it is puzzling to find a bird called by one name in the text and another on a plate, as is true of the "French partridge." Mr. Willett writes in an informal and at times bucolic vein, with keen appreciation of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The BOOK SHOP

THE AMERICAN MUSEUM OF NATURAL HISTORY
77th STREET AND CENTRAL PARK WEST, NEW YORK 24, N. Y.

the English countryside and its human as well as avian inhabitants.

The paintings and drawings by Roland Green are an important feature of this book. His recognized ability to capture the character of a bird in a simple black-and-white sketch is often evident here. The colored plates usually depict a family group of birds; one is an engaging study of assorted downy young and nestlings. The low price of this copiously-illustrated volume is presumably a result of its manufacture abroad.

British Birds will be of service to anyone desiring a nontechnical and yet tolerably complete survey of British bird life.

DEAN AMADON.

ALONG YOSEMITE TRAILS

- - - - - - - - by Josef Muench

Hastings House, $2.75

101 pp., 121 illusts.

SCARCELY 26 years after the discovery of Yosemite by the Walker party in 1833, a photograph was taken within the Valley. Sketches had been made four years earlier by Thomas Ayres in 1854. Since then the grandeurs of this stupendous region of glacier-carved valleys have been extolled in pictures for a period of time that now approaches a century. With the possible exception of the Grand Canyon, none of our National Parks has been so frequently described and depicted.

Consequently, it would be presumptuous for any ordinary photographer to prepare an entire album of Yosemite photographs. But readers of NATURAL HISTORY Magazine, *Arizona Highways*, and countless other publications know that Josef Muench is no ordinary photographer. His pictures of the West are unsurpassed, and in this volume the reader is privileged to see 121 of the finest ever made within the boundaries of Yosemite National Park.

As Joyce Rockwood Muench points out in a brief introduction, the Valley itself is "a scenic gem of the first magnitude" contained within an area of eight square miles. Yet few realize that the 1189 square miles included in the preserve are "far from being a buffer region to keep intact the core of the park. It is an empire in itself, repeating with a thousand variations, the same formations and grandeurs of the smaller part." Josef Muench has singled out the spectacular and the beautiful as only he could do it.

The photographer of 1859 would stare agape at the fine gravure reproductions depicting not only the famous falls and towering cliffs but also the lakes, big trees, camps, flowers, pack animals, deer, and bear—and the reader of 1949 will stare with admiration at the results obtained by a top-notch artist with a camera.

C. M. BOGERT.

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TROPICAL BIRDS FROM PLATES BY JOHN GOULD

With an Introduction and Notes on the Plates by Sacheverell Sitwell

B. T. Batsford Ltd.: London,
New York, Toronto, $2.00

12 pp., 16 color plates

JOHN GOULD was the nearest equivalent to Audubon in Great Britain. Between 1830 and 1880, he completed 41 large folio volumes with no fewer than 2999 hand-colored plates. This incredible output was the result of collaboration between Gould, the ornithologist, and a group of artists including Mrs. Gould, Edward Lear, H. C. Richter, and William Hart.

One cannot argue about tastes, but there are many who prefer the simplicity of the Gould plates to the elaborate body postures of Audubon's birds. Gould plates have now become collectors' items, and it will be appreciated by many lovers of bird art that 16 of the most colorful bird plates are now available here in an excellent offset reprint. The descriptive text does not measure up to the beauty of the plates. In addition to numerous errors, it is full of cheaply "clever" characterizations of birds, such as this one about the Spotted Kingfisher: "Something of an ascetic, like the gurus or holymen of the caverns in the mountains, and this King-hunter, as it should be called, has some of the appearance and imputed wisdom of the Hindu sage." The beautiful reproduction of the Gould plates more than makes up for the inadequate text.

E. MAYR.

COPSFORD

- - - - - by Walter J. C. Murray

George Allen and Unwin Limited,
Ruskin House, London

The Macmillan Co., New York, $3.50

164 pp., 23 illusts.

COPSFORD might well be classed as a eulogy on the struggle between man and the infringing forces of nature. It is the autobiographical story of a man who left a dingy flat on a back street in London for the solitude of a desolate, half-ruined cottage in rural England, which had neither road nor footpath connecting it with habitation. From the very first, the author is disturbed by the oppressive loneliness of the place, which numbs his will and saps his strength. He wages war against a legion of wild creatures that contest his legal right to live at Copsford and ekes out a meager living by harvesting wild herbs. Although eventually beaten at the post, he carries on a winning battle for a year among the wild creatures and plants around him. He is there for a purpose, but the reader is kept in intriguing suspense until the fifth chapter before he is given any inkling of the type of work this city-bred man is doing at Copsford. The reader is somewhat reminded of the Pied Piper, White's Selberne, and perhaps Dickens's *Christmas Carol.*

This strange and yet amusing story reveals the author's intimate experiences with the wildlife in a countryside of unspoiled woodlands, meadows, and brooks. He seems to have lived and felt with the plants and animals he describes for us. Light and darkness, summer and winter —vital things to nature's children—become part of his life as well as theirs.

Walter J. C. Murray is one of the small band of naturalists who can write. *Copsford* is a pleasure to read for itself alone, as the following quotation will show. "What else is there so tragic as the loss of a life-form that can never reappear? I know it has happened hundreds, more probably thousands of times in the past; creatures have, as it were, taken the wrong turning to find themselves in a blind alley from where there is no retreat, only extinction . . . but it comes as something of a shock that the Large Copper Butterfly on the wing within living memory is as extinct as those monsters of the Cretaceous Age."

GEORGE G. GOODWIN.

ATLANTIC REEF CORALS

- - - - - by F. G. Walton Smith

Univ. of Miami Press, Distributed by
Farrar and Rinehart, $3.75

112 pp., 41 plates

THIS little handbook fills a long-felt want for a convenient means of identifying the reef corals from the tropical waters of the western Atlantic. It is indeed a sad commentary on the present state of invertebrate taxonomy in this country that until the publication of Dr. Smith's earlier key in 1943, anyone wishing to identify one of these important and conspicuous organisms had to consult a specialist or search through a large number of incomplete and highly technical reports, usually to be found only in very large libraries. The key and descriptions in the *Atlantic Reef Corals* are accurate, written in nontechnical lan-

Continued on page 48

SEA AND LAND SHELLS

If you are a buyer of this class of invertebrates send for my Conchological Chatter which appears monthly listing choice Mollusca from every part of the world. Collections for sale of any size up to 5000 species. Also books on Mollusca.

WALTER F. WEBB
2515 Second Ave. North. St. Petersburg 6, Fla.

▲ A STALWART NATIVE of the Society Islands, where the ceremony was held

FIRE WALKERS *of*

A man who actually participated in this celebrated rite offers his explanation of how it is possible to walk across a bed of hot rocks without injury

By WILMON MENARD

All photographs by the author unless otherwise credited

ONE of the strangest ceremonies of the South Seas, still performed on many islands of the far South Pacific, particularly in the eastern Polynesian archipelagoes, is the mysterious ritual of fire walking, in which barefooted natives promenade slowly over a long square pit of rocks heated to a glowing intensity. The participants believe that by this ritual they undergo purification.

For the benefit of those who are skeptical as to the authenticity of the rite, the natives offer themselves for examination before and after walking over the fiery furnace. They do not coat the soles of their feet with a secret salve, nonconductive to heat.

I first witnessed and took part in a fire-walking ceremony upon my return to Tevaitoa, Raiatea, a small island of the Leeward Group in the Society Islands of the far South Pacific. I had come from a long voyage among the islands and atolls of the Marquesas and Paumotu groups, and my Polynesian host and friend, Ari, a native of Raiatea, met me at the small jetty and conveyed the news. His handsome countenance was twitching with suppressed excitement, and he talked with great enthusiasm. The *Umuti* (Fire Walk) was a wonderful thing, indeed!

Chief Terii-Pao, the famous fire walker of Raiatea, had aroused himself from his happy indolence and had gone with his assistants to the sacred valley to prepare for the elaborate ceremony. His assistants, under his watchful eyes, had constructed a huge oven and felled trees for fuel. Now the oven, heaped high with rocks, was ready to be ignited at dawn of the following morning. Terii-Pao and his priests (*tahuas*) had finished their walking and chanting around the oven (*Umu*) and had gone into seclusion to confer with the spirits of the deceased (*tupapaus*) and the Goddesses of the Sky, who would permit them to walk upon the fiery furnace.

Large numbers of natives had paddled in their outrigger canoes and steered their sailing canoes from the adjoining islands of Bora-Bora, Tahaa, Huaheine, and Maupiti to witness the ritual. Many of the canoes were beached upon the strand, loaded to the gunwales with fruits, vegetables, and fishes for the great feast that would follow the fire walking. Skilled dancers from as far away as Tahiti and Moorea had come to entertain.

I sat down with Ari on the veranda of his home facing the blue sunlit lagoon and coral barrier-reefs, foamy with the broken combers of the South Pacific, and he gave me the historical significance of this ancient rite.

Fire walking, according to legend, was the outgrowth of famine. During periods of drought or when hurricanes destroyed the natural foods of the islanders (wild plantains, breadfruit, and coconuts), it was necessary to turn to a food ordinarily scorned by the natives—a tuber contemptuously consigned to the wild pigs of the valleys, who uprooted and subsisted upon it. This was the root of the wild giant arum plant (*ape*), a species of taro that grew rampant in the valleys. The leaves of the ape grow to great heights and are veritable elephant's-ears in shape. Its roots, shaped like large war clubs, grow from two to three feet in length and weigh about twenty or thirty pounds each. In Hawaii and in many islands of the South Pacific, a smaller species of taro, mashed and fermented slightly, is known as the popular *poi.*

Thus the story has it that when starvation threatened, the villagers went to the valleys for the scorned ape roots. Giant arum is one of the most difficult island foods to render digestible. To be cooked thoroughly an intense fire must be prepared, and the tuber must be allowed to bake for many hours. This may possibly account for the lack of interest in this food during periods of plenty, as the islanders of the South Pacific do not welcome excessive labor when fruits are available that can be eaten the moment they are plucked or when the lagoons yield a variety of edible fishes. While a large complement of the villagers were gathering tons and tons of ape, a chosen delegation would prepare a huge *Umu,* in which it could be cooked.

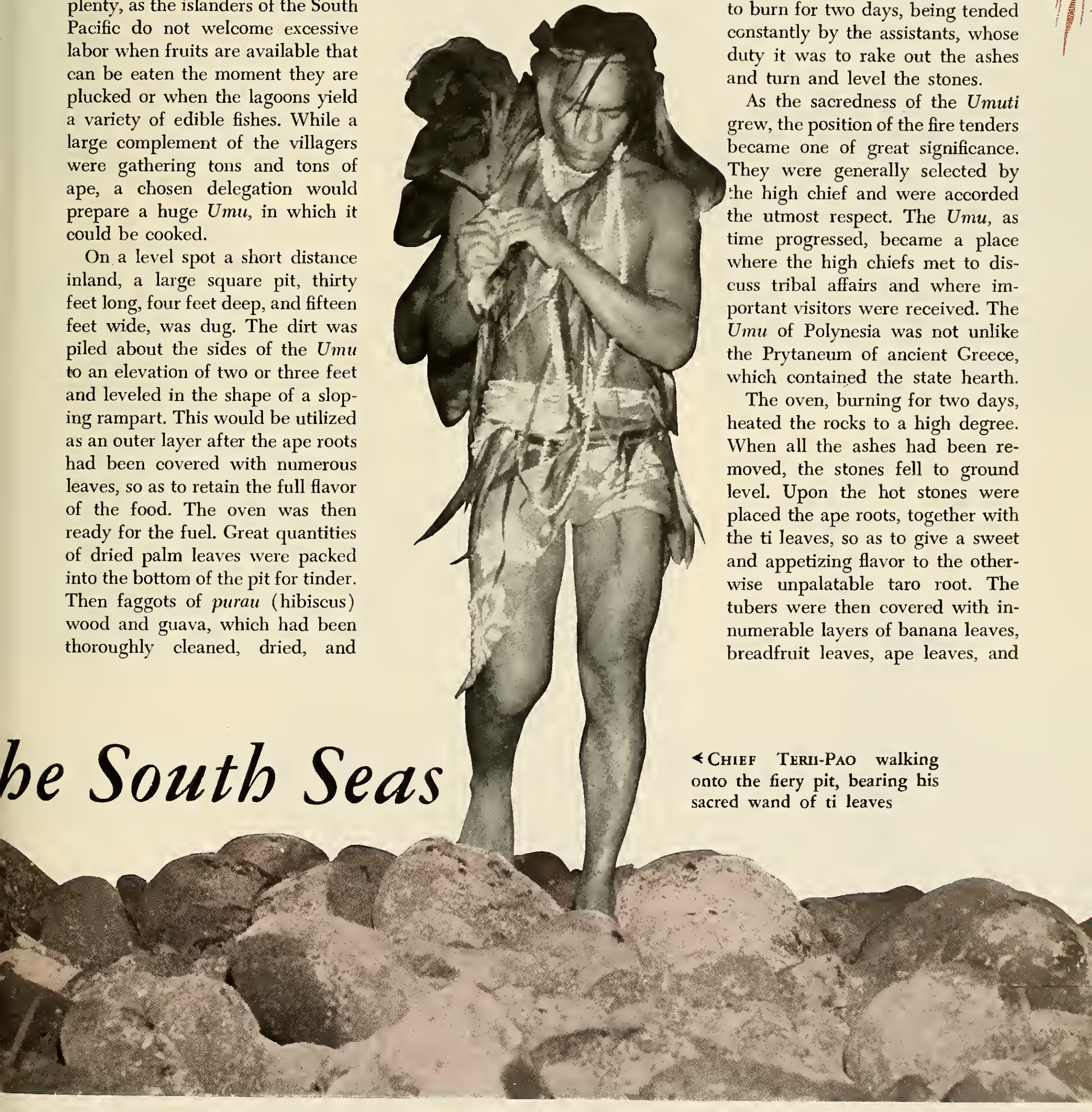
On a level spot a short distance inland, a large square pit, thirty feet long, four feet deep, and fifteen feet wide, was dug. The dirt was piled about the sides of the *Umu* to an elevation of two or three feet and leveled in the shape of a sloping rampart. This would be utilized as an outer layer after the ape roots had been covered with numerous leaves, so as to retain the full flavor of the food. The oven was then ready for the fuel. Great quantities of dried palm leaves were packed into the bottom of the pit for tinder. Then faggots of *purau* (hibiscus) wood and guava, which had been thoroughly cleaned, dried, and stripped of bark in sacred obeisance to the two Goddesses of the Sky and to Maui (God of Fire), were arranged on the tinder. To allow for good circulation of the fire, large green *purau* logs had to be placed in the oven, meeting in the center and resting at each end. Otherwise the palm leaves would be smothered by the great pressure of the boulders and would not continue to blaze freely until the larger pieces of wood had caught fire. When the oven was at last ready for the rocks, boulders of lava, basalt, and volcanic stone, larger than a man's head, were placed on the pyre to a height of five or six feet.

The *Umu* was then ceremoniously lighted by a specially chosen *tahua.* Dances were held before the blaze, religious songs (*utes*) were chanted, and prayers were offered up before the oven by the *tahuas.* The *Umu* was then allowed to burn for two days, being tended constantly by the assistants, whose duty it was to rake out the ashes and turn and level the stones.

As the sacredness of the *Umuti* grew, the position of the fire tenders became one of great significance. They were generally selected by the high chief and were accorded the utmost respect. The *Umu,* as time progressed, became a place where the high chiefs met to discuss tribal affairs and where important visitors were received. The *Umu* of Polynesia was not unlike the Prytaneum of ancient Greece, which contained the state hearth.

The oven, burning for two days, heated the rocks to a high degree. When all the ashes had been removed, the stones fell to ground level. Upon the hot stones were placed the ape roots, together with the ti leaves, so as to give a sweet and appetizing flavor to the otherwise unpalatable taro root. The tubers were then covered with innumerable layers of banana leaves, breadfruit leaves, ape leaves, and

he South Seas



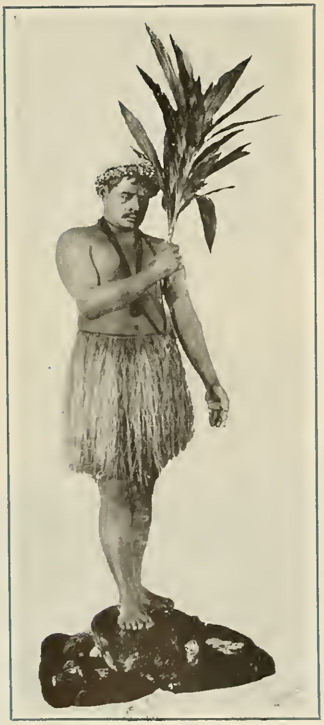
◄ Chief Terii-Pao walking onto the fiery pit, bearing his sacred wand of ti leaves

◀ COMMEMORATING a legendary release from famine, the fire-walking ceremony is accompanied by a great feast. Here natives are bringing fruits for the celebration that follows the rites

▶ PREPARING foods for the oven. The ceremony has solemn meaning, but the mood is otherwise light and gay, as at most South Sea festivals

▼ A SCIENTIFICALLY ACCURATE MODEL of a South Seas fire walker, on display at the American Museum

AMNH photo



finally with a heavy layer of earth to retain the heat. The *Umu* remained covered for ten hours, during which dances, songs, and speeches were given. When the dirt and leaves were removed, the ape and ti were taken by the women in large mixing bowls and mashed together into a glutinous pudding. It was then packed into long joints of bamboo and stored away so as to tide the villagers over the temporary famine.

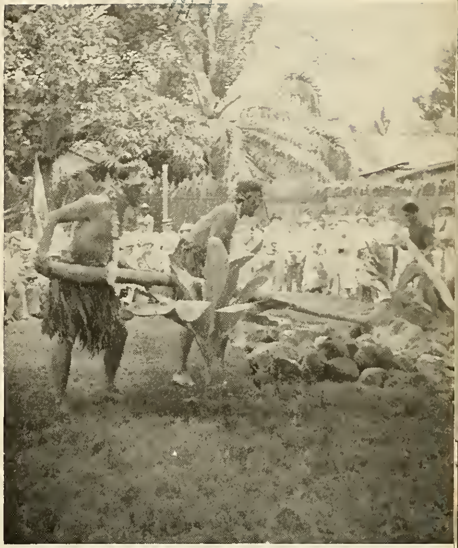
As time went on, legend tells us, the *Umu* played an increasingly important part in their existence, and finally great interest was directed to the supposed power governing the fiery oven. Appreciative of the gift of fire, which enabled them to prepare the food in time of dire need, they showed their gratitude to the two great goddesses of ancient days—the highly reputed Hina-nui-te-a'ara (Great Gray of Scented Herbs), who became Goddess of the Moon, and Vahine-nui-tahu-rai (Great Woman Who Set Fire To The Sky). These two goddesses, as folklore maintains, were always dressed in shirts, garlands, and wreaths of the shredded green-and-yellow leaves of the ti plant, which emit a sweet odor and are held as a sacred symbol of the two goddesses.

Honoring these two goddesses and the God of Fire just before the food was placed upon the hot rocks, the native priest led his followers across the fiery pit, dressed in ti leaves, bearing wands of ti, and calling upon their departed ancestors to cast themselves upon the hot rocks to ensure safe transit. Today the ceremony is still enacted, though the *Umu* is prepared not because of famine but as worship to the two goddesses and Maui and for self-purification.

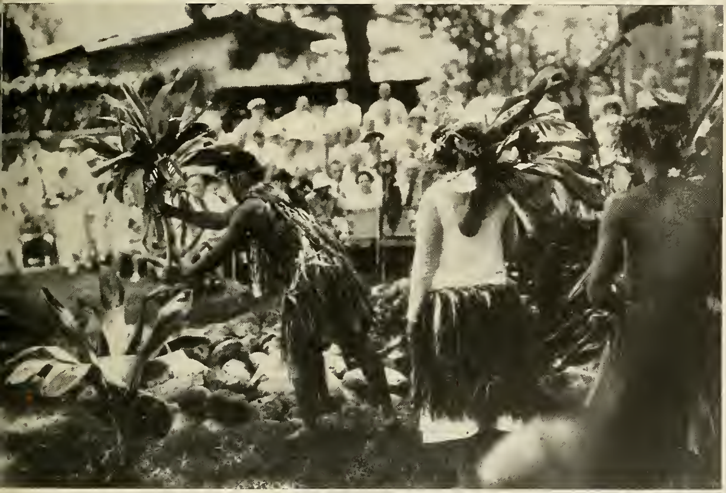
The *Umuti* of Raiatea was to be held in a valley a short distance from Ari's plantation. The location was not more than a half hour's leisurely stroll, so at three o'clock the next morning we started off in darkness. The jaunt to the *Umu* on this occasion is a memory I shall always cherish. The early morning air was heavily saturated with the exotic odor of flowers. There was deep silence, save for the distant booming of the great southern ocean over the barrier coral reefs of Raiatea. It was as if we were alone in an unknown paradise.

But as we journeyed up the valley, we met groups of natives, who cried out to us cheerily: *"Ia ora na! Maitai oe? Haere Umuti?* (Greetings! You are well and content? Do you go to the oven of the fire walk?)"

The short valley widened into

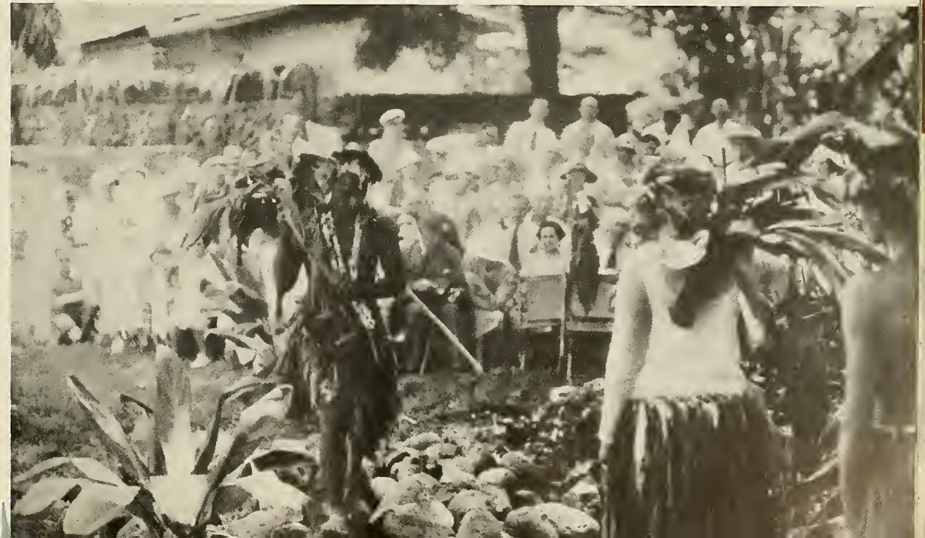


▲ Selected natives level the incandescent stones in preparation for the fire walk



◄ Chief Terii-Pao chants to the Fire God and waves his wand of ti leaves over the fire pit. Bushes transplanted on either side of the oven are ti, sacred plant of the Fire God

➤ The chief traversing the hot stones barefooted and without special treatment to his feet



➤ **Dancers** performing at the fire-walking ceremony

a large clearing bordered by coconut trees and lighted by candlenut torches. In the center was the *Umu*, piled high with large rocks. A great crowd of natives were squatting about the oven, smoking, chatting, singing, and laughing. The quivering shafts of light from the torches fell across broad, naked shoulders, momentarily revealing and obscuring handsome Polynesian faces. It was a spectacular sight.

On the far side of the clearing was a small thatched hut in which Chief Terii-Pao and his *tahuas* were praying to Maui. A few minutes after our arrival, Terii-Pao strode from the enclosure with his followers, and a sudden hush fell among the assembled natives. They hurriedly moved away from the *Umu* to the edge of the clearing, regarding the Fire-walking Chief with awe and reverence. He was a magnificent figure in the torchlight, nude save for a *pareu* and ti leaves about his waist. The fine head set upon sturdy shoulders, the noble features, with wide quivering nostrils and flashing eyes, commanded admiration and proclaimed him to be a favored son of Maui, the God of Fire. At the four corners of the pit were transplanted ti plants, which remained green and unwilted even after the fire had burned for many hours.

Terii-Pao, after walking twice about the *Umu* to see that everything was in readiness, withdrew, and a *tahua*—a short, bowed man—slowly approached the fire pit, bearing two sticks in the crook of his arm. He marched solemnly about the oven, chanting in a loud voice. Then, while the entire crowd chanted, he kneeled before a trench that had been dug into the oven for lighting the fuel and vigorously began to rub the two sticks together. As the lighting of the *Umu* is considered an extremely sacred part of the fire walk, the torch to set the oven ablaze must be kindled by rubbing two pieces of wood together.

The *tahua* had a difficult time obtaining a spark. He labored strenuously, and I could see by the glare of the torches that perspiration was streaming from his body. Suppressed laughter buzzed among the spectators. The *tahua* glanced about him with a peeved expression. Terii-Pao's face clouded with impatience and indignation.

Suddenly a flippant youth be-

◄ **In Fiji**, as in the Society Islands, fire walking is also a sacred ceremony. Here are the head fire walkers of the island of Upolu hind me cried out clearly: "*Na toetoe te raau, na veavea te taata!*" which, translated, means: "The wood is cold, but the man is hot!" This cry was taken up by the crowd and continued until Terii-Pao, with a loud cry of "*Maniania!* (Be silent!)" approached the oven, took the sticks from the *tahua,* who sheepishly withdrew, and in a short time had a blaze with which to fire the *Umu.* As the dry tinder caught and the flames leaped high, the natives cried in a mighty chorus: "*E era!* (There she goes!)"

The two days necessary for the heating of the rocks sped by quickly. On the evening of the second day, we walked to the valley to see the *Umu* in darkness. I could feel the great heat 50 feet away. The shimmering pit of glowing fire recalled to mind the lava pits in the vicinity of Kilauea, in the Hawaiian Islands. The *Umuti* would be held promptly at dawn on the morrow.

Ari and I were back at the *Umu* at the first light of daybreak. The edges of the clearing were packed with natives of Raiatea and the adjoining isles. Old Polynesian grannies smoked and gossiped, occasionally breaking out in cackling laughter over some delicious morsel of scandal. Small children frisked about, got into mischief, and were spanked soundly. Young damsels flirted with gay lotharios of the islands. On every side was laughter and song. It was a happy and colorful gathering, typical of the lighthearted Polynesian spirit at festival time. A small group of tourists, who had arrived from Papeete the preceding day, stood a short distance away, carrying on a garrulous conversation concerning their "solutions" to the fire walk.

On the ramparts about the oven, on clean mats of woven pandanus leaves, were great mounds of the green-skinned, globular breadfruit, piles of wild plantain, bananas ready for roasting, and fishes wrapped in green leaves. Four large pigs, cleaned and stuffed with chestnuts, rested on their sides. There were yams, taro tops and pork, papaya poi, and fresh-water eels prepared with a sauce of fine wine. Indeed, a sumptuous feast was to follow the *Umuti.*

Terii-Pao suddenly appeared close to the *Umu.* His followers leaped to their feet behind him. I could feel the intense excitement that swept the clearing at his appearance. The Fire-walking Chief was a splendid figure among his assistants.

The group of tourists rushed over to Terii-Pao and surrounded him for an intensive inspection of his feet and whatever else might have been concealed "up his sleeve." He submitted indulgently, smiling at their thorough examination. One of the tourists turned suddenly and

▲ SAMOANS, too, have a fire-walking event. Here a *taupoo* (virgin) of the village chants to the Fire God, hoping for assurance that the walkers will cross the fiery oven safely approached the edge of the oven. Looking full into the pit for only an instant, he groaned, clapped his hands to his face, and backed away. The *Umu* was hot! Another tourist tossed a linen handkerchief upon the rocks, and in a second it was reduced to gray powder. And upon these stones the fire walkers were going to march with bare feet! The self-appointed board of examiners withdrew from the Chief with disappointed expressions. They had been unable to find anything suggesting trickery.

Now Terii-Pao, his head held high, walked toward the end of the oven nearest me, a branch of ti leaves in his hand. He halted at the edge of the oven and struck the rocks three times with the leaves, chanting in a low voice. His assistants, close behind, lifted their voices in the *Umuti* chant. Terii-Pao's voice became louder, and the great cords in his neck swelled. His eyes were still uplifted.

The chant was: "*E na ta'ata e tahutahu i te umu e, a ta pohe na!* . . ." and so forth.

Translated, it means: "O being (spirits) who enchant the oven, let it die out for a while! O dark earthworms! O light earthworms! Fresh water and salt water, heat of the oven, darkening of the oven, hold up the footsteps of the walkers and fan the heat of the bed. O cold host, let us linger in the midst of the oven. O Vahine-nui-tahu-rai, hold the fan, and let us go into the oven for a little while.

"Holder of the first footstep!
Holder of the second footstep!
. . . .
Holder of the tenth footstep!
O Vahine-nui-tahu-rai! All is covered!"

I shall never forget the great sigh and then the hush that followed Terii-Pao's first step upon the oven. He hesitated a moment, as if to be sure that the stones would not shift under his weight, and then—*he walked onto the hot rocks!* He strode once across the pit and then turned and recrossed it. His followers formed in a line behind him when he returned. The spectators, native and tourist alike, were spellbound. Again the Fire-walking Chief struck the stones with his branch of ti leaves. Terii-Pao and his *tahuas* walked with firm steps across the center of the *Umu*. I could see the great heat waves rising above their heads, but there was no odor of burning flesh as I had half expected. They had traversed the oven now, and Terii-Pao raised his ti leaves to signal the column to about-face and march back over the pit. They traversed the *Umu* three times.

Following the third crossing, Chief Terii-Pao called out, "*Atira!* (Enough!)"

Then he quickly turned and *crawled across the oven on his stomach!*

On the other side, Terii-Pao stood up and faced the astounded tourists. They, understanding that he was ready to be examined, gathered about him. The Chief and his followers lifted their feet, so that they could be viewed and handled. The soles, as I could see, were not even marked, and one tourist who placed his hand against them announced that they were "cold as ice."

Now Terii-Pao exhorted the natives to follow him across the *Umu*. Passing close to me, he caught my eyes, grinned, and said, "Will you not walk behind me on the oven? You have lived long in our islands and understand our customs. You will surely not be harmed if you follow close behind me, keep your head up, be quiet, and don't stumble."

"Why don't you?" yelled the tourists.

"*Haere!* (Go ahead!)" urged Ari and the assembled natives.

"*Tu, tu, tu, e!* (Come, come, come!)" persisted Terii-Pao.

I cannot say that the prospect of walking on the hot stones was agreeable to me, and I wavered. Terii-Pao gave me a broad smile, which might have meant, "Are you afraid?" It was this that prompted me to kick off my sneakers, remove my socks, and cry, "*Haere otou!* (Let's go!)"

A great shout of approval came from the native spectators.

I stepped into line behind Terii-Pao. There was a taut feeling in the pit of my stomach. My heart was beating hard, my head ached, and I wanted to bolt. I have always had a great fear of fire, and now that fright was intensified. The *tahua* behind pushed me gently. Terii-Pao had started!

I gritted my teeth and groaned inwardly. I began to walk mechanically. Every step I rebuked myself: "You fool, now look what you've let yourself in for!" My legs felt numb and leaden. Then my bare feet touched something uneven and elevated. In the next instant, countless tiny electric shocks struck the soles of my feet. It was like the sudden contact of the skin with sharp needles. Great heat waves rose about my head, compelling me to half close my eyes. It was not unlike the sudden blast of heat that strikes one when opening the doors of a huge furnace. I had experienced this sensation while standing on the grilled platform above the huge, throbbing engines of an ocean liner, with billows of oily heat taking my breath.

The heat of the oven all but suffocated me. I was unable to draw a normal breath. The heat waves affected the membrane of my nostrils. My lungs became strained, and I feared that I would choke if I did not breathe pure air quickly. From a great distance I could hear the murmuring of the crowd.

Then, suddenly, the prickly sensation on the bottom of my feet ceased, and I knew I had arrived at the far end of the *Umu*. The last in line had not crossed the pit, so we continued walking across the clearing in a straight column. I glanced briefly down at my feet. They were untouched! There were no traces of searing or blistering. I could hardly believe my eyes. My shirt was wet, and I could see that Terii-Pao's broad back was streaming with perspiration. Suddenly, he raised his wand of ti leaves, a signal that the last man had passed over the *Umu* and that everyone should right-about-face for the return trip.

I knew that I could not stand another trip across the hot stones, so I stepped quickly out of line. Terii-Pao smiled and patted me on the back understandingly. The fire walkers moved onto the oven again, and I was left standing 20 feet away, dazed and trembling from head to foot. The tourists grouped about me, highly excited, screaming questions at me from all sides. I had no solution to offer.

Later, Ari and I returned to the valley of the *Umuti* and became perfect gourmands at the bountiful banquet of South Pacific ambrosia heaped before us on tablecloths of banana leaves.

How do I explain fire walking?

First, I suppose there is the control of mind over matter. No one can view the performances of the authentic fakirs of India without believing that a person can develop special control over portions of his anatomy, and it is undeniable that one's reaction to pain depends a great deal upon his state of mind. Rocks of highly porous lava are known to resist the passage of heat, and this may be a fairly important factor in the fire walk. Also, the toughness of one's feet from walking barefooted on the beach would certainly make a difference.

Still, there has to be a more complete explanation for the fire walk. Some years ago the celebrated magician and escape artist, Harry Houdini, made a specialty of unmasking spiritualistic tricksters by explaining the seemingly unexplainable. He asserted that the most complicated trick is the easiest to see through and the simplest the most baffling. As the simplest trick in the world, he offered a young man who permitted himself to be roasted alive.* This trick was so completely simple, he said, that it was practically impossible to see through.

The man permitted himself to be placed in a glass compartment about the size of a telephone booth, the interior of which was made hot enough to cook a steak hanging over his forearm. He was naked except for swimming trunks. He applied wet clay to his eyebrows and fingernails and wore a cup over his hair. Spectators could scarcely believe their eyes when they saw the fat of the steak start to sizzle and drip to the floor, while the man holding it showed no sign of pain or discomfort. When the steak had cooked long enough to be medium

Continued on page 48

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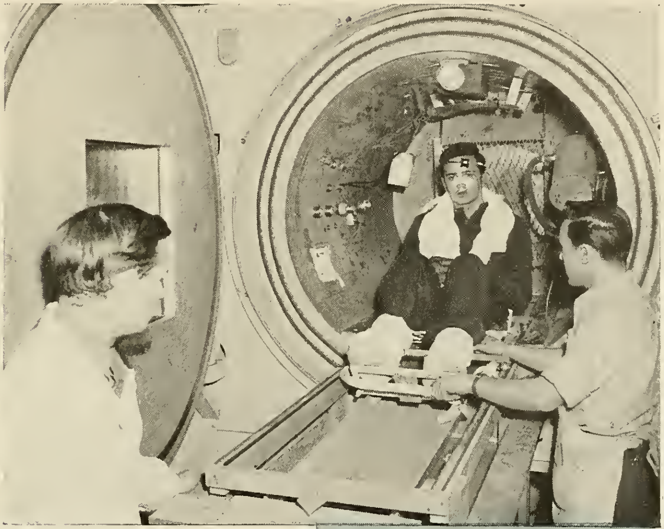
* Described in *Miracle Mongers and Their Methods,* E. P. Dutton, 1920.



Photos from the Univ. of California at Los Angeles

▲ Recent scientific tests show that a human being can endure far more heat than had been imagined. Here volunteer Sidney Friedlander is being wheeled into a specially devised heat chamber for heat tests at the University of California at Los Angeles

◄ The subject perspires copiously as the thermometer creeps past the 200-degree mark. But perspiration is what saves him—the cooling effect of evaporation from his skin. Professor Craig Taylor, supervisor of these experiments, endured 15½ minutes at temperatures between 230 degrees F. and 262 degrees F.

WINTER

Through the Camera's Eye

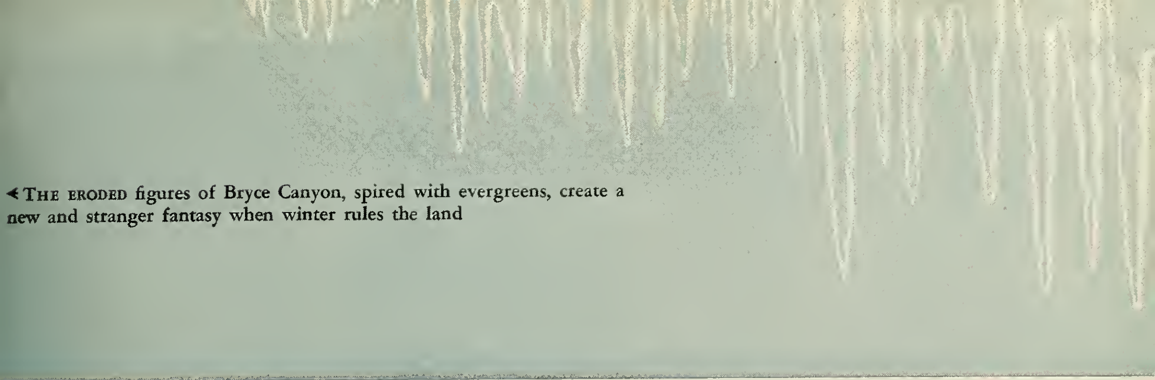
By JOSEF MUENCH

When King Winter casts his spell, mountain and desert voice no humble mood

◄ Ski time. Only the tracks of the hardy break the white blanket that covers the slopes of Mt. Superior in Little Cottonwood Canyon, Utah. Many skiers are drawn to Alta, one of Utah's favorite resorts

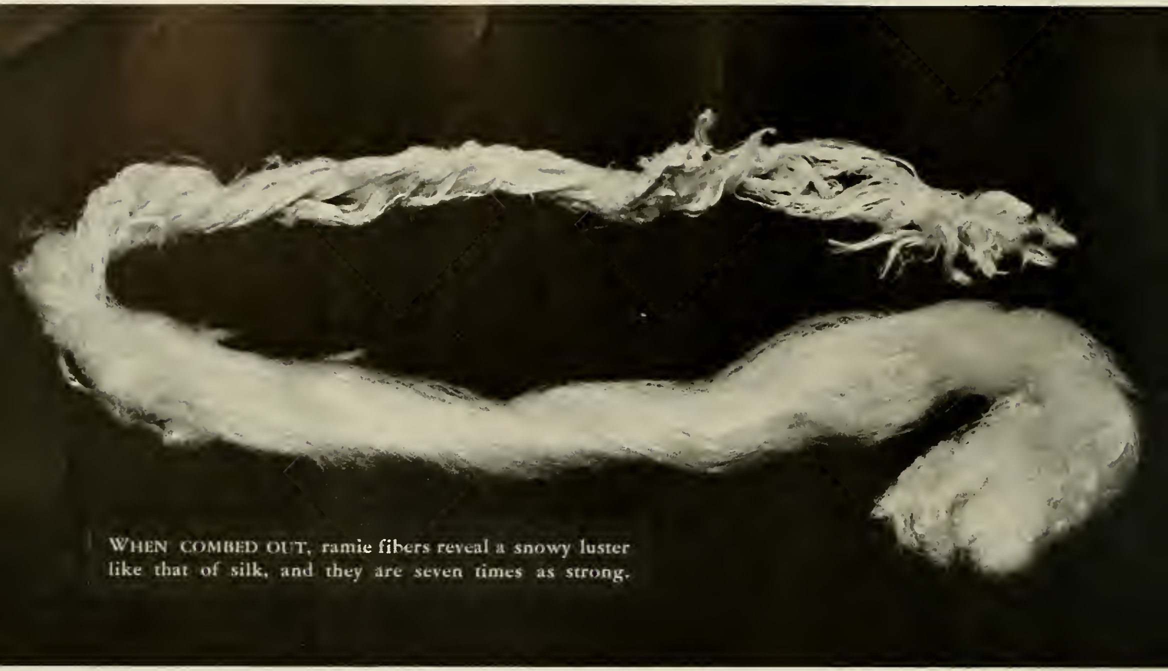
▲ White Ghosts at Bryce Canyon. Balancing on the rim of this natural amphitheater, two evergreens wear the garb of winter and give an unaccustomed aspect to a scene familiar to many in warmer weather

➤ Winter Shadows in Navajo Land. A weak sun throws its shadows at the gate to Goulding's Trading Post. Monument Valley is farther from a railroad than any other point in the United States



◂ THE ERODED figures of Bryce Canyon, spired with evergreens, create a new and stranger fantasy when winter rules the land

▴ A LONELY BUTTE in Monument Valley, framed in the gnarled boughs of a cedar. Even this hot and arid region dons a lacy costume and becomes a part of winter's fairyland



WHEN COMBED OUT, ramie fibers reveal a snowy luster like that of silk, and they are seven times as strong.

AMNH photo

The "Wonder Fiber" Ramie

Far superior to cotton or linen, it was used by the Egyptians for mummy wrappings. But only now do its remarkable properties promise to become of widespread benefit to man

By EUGENE W. NELSON

DURING the past century or so, adventurous investors in almost every country in the world have poured out millions of dollars in a vain attempt to exploit ramie (*Boehmeria nivea*), that fascinating Asiatic perennial which is perhaps the oldest fiber used by man. In a textile sense, ramie has everything, but it has long been a terrific headache to both farmers and textile people because it is a "wonder fiber" that never quite made good—a self-propagating crop with an enormous potential that somehow couldn't make the grade.

Ramie—a shrub belonging to the stinging nettle family but without the stinging hairs common among nettles—sends up tough stalks that are from five to eight feet high. Lying directly underneath the bark of each stalk is a thin layer of individual fibers. Inside this ring of fibers is the woody part of the stalk. It is the fibrous part of the plant that has interested the textile industry, since these fibers possess truly remarkable properties.

Stronger than Cotton or Silk

Ramie is a "bast" fiber, like hemp or linen. That is, the fiber is produced from the stalk and not, as in cotton, from the bloom. In tensile (or pulling) strength and also in resistance to mildew and rotting, ramie is far superior to cotton or linen. In fact, it has eight times the strength of cotton and seven times the strength of silk. Paradoxically, when ramie fibers are wet, their tensile strength is from 60 to 70 per cent greater than when dry. Moreover, these fibers can be combed out almost to the fineness of silk, and their beautiful, snowy-white luster resembles that of silk. Ramie fibers take dyes well and hold colors better than do most fibers. The plant itself is easily grown in our southern states and in many other parts of the world.

Problems in Commercial Production

The Egyptians used ramie fiber for wrapping mummies, and this plant was mentioned in the Imperial Chinese Treatise on Agriculture in 2200 B.C., but to date the production of ramie fiber on anything resembling a commercial scale has been limited to oriental countries having cheap labor. The major fly in the ramie ointment, as far as mass production in the occident is concerned, has been the lack of efficient methods for mechanical decortication. Decortication is the process of removing the bark and pith surrounding the ramie fibers without damaging the fibers themselves. In China, decortication is all done by hand, the workmen scraping the ramie fiber from the green stems with crude implements. In this way, one worker can separate only a few pounds of fiber each day. In our country, of course, any kind of hand process for an operation of this nature would be prohibitively expensive.

Another trouble has been the cost of harvesting a ramie crop. When growing naturally, some ramie plants mature before others, even though all of them were planted at the same time. Even parts of

Photo courtesy Fiber Conversion Corp.

▲ Uniform growth of the crop, recently attained through careful study, makes mechanized harvesting possible. Previously, mature plants had to be selected by hand

Courtesy of Newport Industries

▲ Freshly cut ramie. The fibers are located in a layer between the bark and woody part of the five- to eight-foot stalks

Florida Pictorial Service

➤ Motorized collection of harvested bundles of ramie

Courtesy of Newport Industries

▲ RAW FIBER (right) and degummed fiber (left)

the same cluster will be of a different height and state of maturity. In the past, this has made hand harvesting obligatory and has practically ruled out mechanical harvesting. Recently, however, careful cultivation and fertilization, the use of superior drainage and water control, and over-all good management have smoothed out this uneven growth. Today, ramie plants cultivated in the United States have an even, steady growth that makes mechanical harvesting practical at last.

Processing

With the harvesting problem simplified, there still remained the need for an efficient mechanical decorticating and degumming process. The lack of such a process has been the great holdback to widespread production and use of ramie in this country. Without such a process, no American industry could possibly compete with oriental coolie labor. Nor could an industry be built in this country without uniform quality in the raw material.

Scores of inventors have dreamed up decorticating machines and degumming processes—and in their dreams have become fabulously rich from selling the hard-wearing, shrinkage-resisting "wonder fiber" for use in tire cord, industrial fabrics, and a host of other things.

Machines designed for scraping away the bark and pithy core of the ramie plant from the valuable fibers have been of two general types. There is the larger, centrally located type of decorticator that is capable of separating the fibers from the stems of plants grown on thousands of near-by acres. The other type is a smaller, portable machine that can be set up in the fields where needed.

Courtesy Fiber Conversion Co

▲ REMOVAL OF GUM and woody particles is an important step in the preparation of the fibers for spinning and weaving

Now, at long last, comes convincing word that ramie has finally arrived and will be going places at an ever-increasing pace in the next few years. One of the companies that has been going in for ramie research in a large way has quite recently announced the perfection of a decorticator with a proved daily capacity of 20,000 pounds of ramie fiber. One of these machines (and perhaps more, by now) has been built and is in operation in Florida, where several companies have been growing ramie on a large scale in the rich muck of the Everglades. Ramie technicians claim that they will soon be able to produce ramie fibers at a cost equal to that of the Chinese product.

With solution of the major problems in the growing, harvesting, and processing of ramie fiber on a large scale—what then? Just what sort of a fate lies in store for the erstwhile "problem child" of the textile world? Just a few of ramie's possibilities include corduroy that is definitely better than the standard cotton corduroy, inexpensive suits that can't be distinguished from all wool, and conveyor belts and other industrial fabrics for use where "wet strength" is important. Because it is stronger when wet, ramie also makes superior cordage, fishing nets, and sails. Longer-wearing sheets, pillow cases, toweling (ramie absorbs water even better than cotton does), and draperies as well as bandages, upholstery fabrics, and carpet backing are also on the ever-growing list of uses for ramie fiber. Bank-note paper having better wearing qualities than the kind now being used is still another possibility. In fact, it is a matter of sober record that ramie fiber is adapted to the widest range of uses among known textiles.

Ramie can be used alone or in combination with cotton, rayon, and wool. When combined with rayon, for instance, ramie produces a material for shirts and summer dresses that absorbs perspiration and then dries out very quickly.

Wide Uses

The fiber, however, is only a small part of the entire plant, according to the ramie experts. Here are some of the uses recently discovered by chemists for the rest of the plant after the fibers have been extracted. Ramie leaves and stalk tops make a cattle feed especially rich in carotene (for vitamin A) and protein. Its yield per acre is said to be higher than any other protein-producing vegetable. Ramie sauce for cooking is claimed to have a salty meatlike taste. It has been suggested that this sauce will be a boon to people who are on a saltless diet. And ramie "waste" has been forced to yield such valuable chemicals as chlorophyll, xanthophyll, and industrial proteins—all potentially valuable in chemical processes.

The most recent developments have had to do with uses for ramie gums. The major component of ramie gum is pectin. This substance is widely used in the food and cosmetic industries. It is also useful in the sizing of cotton yarns and fabrics and in adhesives, cleansing agents, printing inks, and a host of other industrial products. The chief sources for pectin in the United States have been apples, citrus rind, and grape pulp. In Europe, enterprising producers have turned to lower-cost sources, such as sugar beets, vegetables, flax, and ramie, which, although they yield a pectin that is lower in jellying power (the most important property for the food industry), provide inexpensive pectin that is highly satisfactory for technical and industrial purposes.

Ramie may play a part in the reconstruction of oriental countries damaged by war. The Philippine Government has engaged the services of one of the large American firms interested in this plant and are now making a complete survey with the view to recommending establishment of a fully mechanized ramie industry in the Islands. Several other countries where ramie has been grown successfully are reported to be considering similar steps.

Florida Pictorial Service

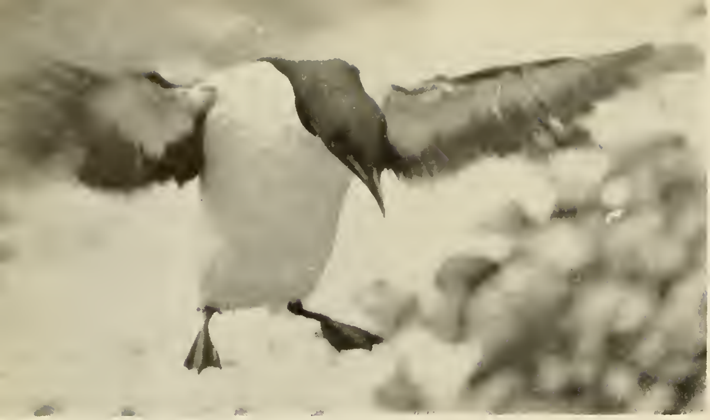
▲ **Baled for shipment.** The fiber that was known to the Chinese 4000 years ago is just now trying its strength in world industry

Ramie is usually propagated from rootstocks, or rhizomes, although it can be grown from seed. When starting a new field, sections of rhizome four inches long, each having several eyes, are set at two-and-one-half-foot intervals in rows four feet apart and covered with about two inches of soil. These rhizome sections usually burst into life within two weeks.

During the first year in a new field, the weeds have to be controlled. After that, the perennial usually becomes so well established that it crowds out all other growths so that weeds are no longer a headache. Ramie rhizomes ordinarily send up a new growth each spring. But if the stems are cut during the growing season—which in Florida lasts for eight months out of the year, from April to December—a new crop starts to grow at once. The shrubs may reach a height of from five to eight feet within a period of about two months. Thus, under favorable conditions, three or even four crops may be obtained each season for ten years or even longer without replanting. A crop like that is enough to make any farmer's mouth water.

In the various ramie fields now under cultivation in Florida, the crop is harvested by a special combined harvester and binder which delivers stalks in 50- to 60-pound bundles. After the bark and pith have been removed in a decorticator, the waxes and gums are extracted chemically from the remaining fibers. The ramie is then dried and baled and may be processed as any other fiber.

It is quite possible that this ancient plant may provide a new crop of major importance and a source of additional wealth for our southern and southwestern states.



◄ SINCE THE MURRE has relatively small wings for its heavy body, its flight is rapid and direct. Here the bird puts on all air brakes, back-pedaling with rapid wing strokes while presenting its flat underside to help cut down its forward speed

Mu

MARINERS O

Hardy and seaworthy,
the northern sea and w
on the wind-lashed

By KARL
U. S. Fish an
Photographs by the auth

ONE chilly afternoon in July, I stood near the brink of a sheer 200-foot cliff on the Island of St. Paul, in the Pribilof group in Bering Sea. At my feet the yellow arctic poppies buried their heads among the long whipping strands of rye grass, as a wet wind bent its force over the cliff's edge. Below, roaring breakers pounded a beach littered with black volcanic rock, tossing aloft a curtain of salty spray that joined the fog-laden wind rushing down from the northwest over the dismal, gray surface of the Bering Sea.

Like missiles from some hidden flotilla, the dripping wind bore thousands of birds toward the mist-shrouded cliffs. Each bird headed instinctively through the blinding fog to a certain nesting ledge or cranny. In endless streams the birds arrived. Each individual skimmed low over the surface of the sea until within sight of the nesting cliffs, then gracefully zoomed upward in a steep curve, losing speed before it deftly settled among others of its kind already crowding the ledges. As constantly as new birds arrived, others streamed away toward hidden fishing grounds.

Most of the birds thus approaching and leaving the cliffs were Pallas Murres, with a few California Murres. The vertical updrafts near the cliff's top swarmed with a cloud of other kinds of birds. Screaming kittiwakes, soaring fulmars, and clumsy, inquisitive puffins predominated in this milling mass. The murres spent no time drifting about. They flew directly from cliff ledge to the open sea. Having a comparatively heavy body and small wings, the murre is specialized for swimming rather than flight. Even in executing necessary aerial maneuvers the murre must go beyond the use of the structures designed strictly as implements of aerial control.

As many of the birds launched themselves into the air, they used their feet as supplementary horizontal stabilizers. Apparently the tail is so small that at low speeds it does not offer adequate control surface. This is especially noticeable when the birds are leaving a cliff or the surface of the water. Thus, while taking off, the murre frequently spreads both its webbed feet, holding them flat and stiffly extended on each side of the tail where they supplement its action, providing additional control.

In addition to employing its feet

Photo by Dick Bolding

◄ ON TINY volcanic Bogoslof Island in the Aleutians, murres crowd all rocky areas, because there are no predators to molest them

res –

THE NORTH

y survive the rigors of
a precarious existence
ffs of the Pribilofs

Kenyon
ldlife Service

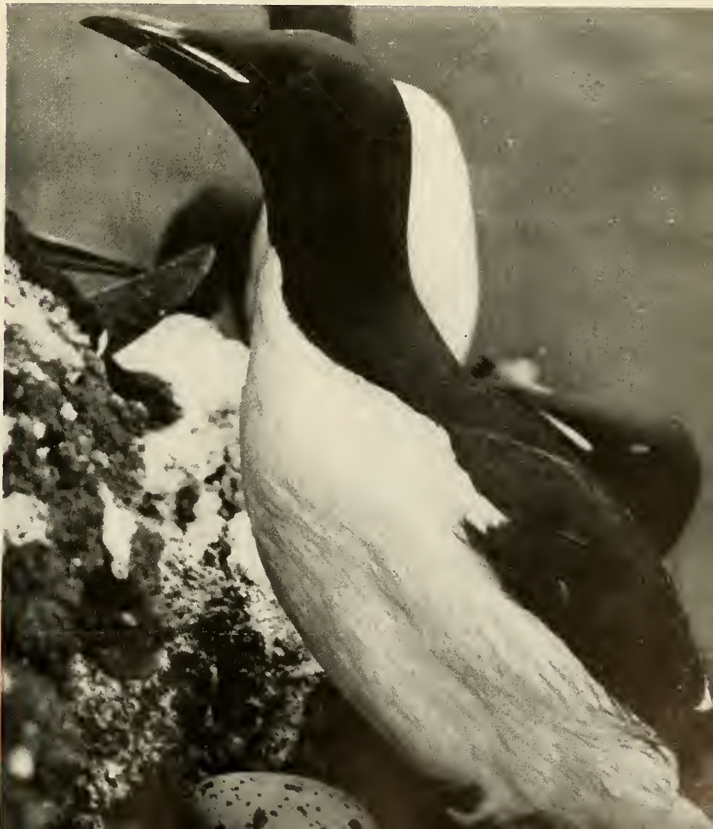
less otherwise indicated

➤ A pair of courting Pallas Murres pose for Dr. Scheffer's camera. They appeared so interested in each other that they completely ignored their human observer

to supplement its aerial equipment, the murre uses its flying equipment under water. It depends on its wings to increase speed while pursuing the fishes upon which it lives. As we approached the Pribilof Islands by ship many murres took to the depths as a means of escaping the oncoming vessel. As they headed down through the dark water near the bow, our view of their wildly flapping wings showed clearly how useful these members are under water.

Being a bird of the open sea, the murre appears most at home on or beneath the surface of the water. The break from an aquatic to an aerial environment is accomplished awkwardly. In order to gain flying speed the bird usually patters across the water, using its feet to help the rapidly beating wings. It may continue thus for many yards before it is able to lift its bulky body a few inches above the surface. Some drop heavily back, apparently reluctant to make the final effort. Still others appear to make no attempt to become air-borne but, using their wings as giant oars, simply hydroplane on their breasts a safe distance from an approaching ship, then settle back on the water again.

Murres sitting bolt upright in rows along the cliffs resemble small penguins. Their black backs and white breasts add to their masquerade. However, murres and penguins are widely separated, anatomically as well as geographically. Murres are circumpolar in the northern hemisphere, penguins in the southern. The two groups never



➤ Pallas Murres sharing one of Bogoslof's nesting cliffs

◀ **The white "mustache"** identifies this bird as a Pallas Murre. The sharply conical shape of its egg helps to prevent it from rolling off the 300-foot drop

▲ **The murres** generally lead a quiet life, spending a good deal of time affectionately caressing their mates with their bills

mix. Murres, like many other aquatic birds, have their legs placed far back on the body as an aid to rapid locomotion under water. The upright standing posture that results from this arrangement appears to offer several advantages to the murre in its particular way of life. The bird is thus able to stand upright on a tiny ledge of cliff that would otherwise be too small for it.

On this particular day, as I stood at the brink of the cliff, I witnessed another advantage in this upright posture. Seeping moisture had loosened a small portion of the cliff edge, which suddenly gave way. Perhaps a bucketful of loose earth and small pebbles showered down over the rows of courting and incubating birds. I expected them to leave their ledges and seek safety in the air. However, I was surprised to see that instead, the murres stood in close to the cliff and pointed their bills upward. In this way they successfully dodged the larger pebbles and "streamlined" themselves against the smaller debris, which pelted their thick feathers but rolled off as harmlessly as "water off a duck's back." They thus saved their eggs, with no apparent discomfort to themselves.

St. Paul's moisture-sodden cliffs are constantly crumbling. As the storm-driven waves eat away their bases, the summer melting of snows loosens rocks and earth. Chunks break away, leaving the narrow ledges and shelves upon which the murres lay their eggs. Murres do not built a nest. The eggs are, fortunately, particularly tough-shelled and seldom break even though they rest on the bare rock. As they lie in rows along a ledge of black rock, they form a colorful array, ranging from nearly white through various shades of blue and green, marked with dark lines and smears. Their sharply conical shape is an advantage on the narrow ledges where they are laid, because it causes them to roll in a tight circle, lessening their chances of falling from the cliff. In spite of this, many go over the edge if the murres are suddenly frightened into the air.

On the island of Bogoslof, in the Aleutian chain, I suddenly rounded a rocky outcropping and came upon a murre colony unexpectedly. The birds stampeded toward the sea, sending several eggs bouncing from their resting place down a 20-foot slope. Although some were broken, I examined others that had survived enough tumbling to shatter any ordinary egg and found that their tough shells were only slightly dented in a few spots.

The view of a cliff covered with murres generally presents a peaceful if constantly moving panorama.

Photo by Y. B. Scheffer

◀ **Aleuts** have gathered murre eggs for many years. Although this looks like quite a load of eggs, it is only a small fraction of the tremendous number to be found on Walrus Island

For the most part the birds lead a quiet domestic life, spending a good deal of time affectionately caressing their mates with their bills and making soft vocal sounds remindful of a somewhat muffled human chuckle.

However, the ledges appear sometimes to become too crowded for the tolerance of even these patient creatures. One rare afternoon when the sun had dispersed the persistent fog and the cliffs and meadows glistened above the sea in unusual brightness, I watched the customary flow of birds to and from the cliffs. A sharp, raucous squawk attracted my attention to a pair of murres engaged in an argument over a small ledge. They were insistently crowding each other for possession. One suddenly jabbed his neighbor with an angry peck, precipitating a violent emotional outbreak. Each bird grabbed a billful of the other's feathers. This threw both off balance and plunged them in a tangle of wildly thrashing wings, necks, and feet into the gusty sea breeze. Even the fact of their falling seemed not to affect their feelings. Not until the struggling pair had dropped 50 feet or more did they separate, spread their wings, and head out to sea. This was still not the end of the battle. Both birds had barely gained aerial control and were flying a few feet apart when the aftermost uttered an angry cry, accelerated rapidly, reached forward, and grasped the leader's flank feathers. Twisting and jerking sharply, this aggressive action caused both to swerve giddily and lose several feet of altitude before they separated again. Still unsatisfied, the trailing bird again speeded up, bumping the other from behind. For a moment wings and feathers were mixed, but when the two separated the fight was over and they moved quietly out to sea, apparently having forgotten what the quarrel was about.

Murres' eggs are a valuable asset to the Pribilof islanders. After a long, cold winter with little fresh food, the spring trip to near-by Walrus Island, a flat-topped rock about a third of a mile long, is a very important affair. Here the nesting murres cover every available inch of rock. The skiff-load of eggs gathered is only a fraction of those available, and since the birds will lay a second egg about nine days or more after the first is taken, this egg-gathering is not detrimental to the murre population. After many years of such expeditions the birds continue to cover every available nesting spot every season. Murres' eggs, unlike the distasteful eggs of such fish-eating birds as the cormorant, closely resemble ordinary chicken eggs both in flavor and consistency.

Murres' eggs are so palatable, in

Photo by Dick Bolding

▲ A SHEAR NESTING CLIFF on Bogoslof Island in the Aleutian chain

▲ BLUE FOXES like this one gather the few murre eggs injudiciously laid within their reach along the cliffs of the Pribilof Islands

➤ THEY SCATTER the eggshells after breaking the eggs and licking out the insides

◂THE RESEMBLANCE of these California murres to penguins is purely coincidental. They have lived at the Seaside Aquarium in Oregon since they were rescued from the beach in an oil-soaked condition

fact, that their wholesale exploitation for the public markets during the early days of American settlement nearly caused their extermination. From 1850 to 1856, between three and four million murre eggs were taken from the Farallon Islands to the markets of San Francisco. The second egg laid by the birds was not left for hatching in those days, and when the murres began to disappear, they were given legal protection and have now resumed their former place as one of the most numerous sea birds within their range.

While murres are hardy birds, accustomed to the rigors of the sea, they are unable to cope with certain conditions imposed on them by human carelessness. Oil lost or dumped from ships at sea saturates their feathers, and thousands perish every year when they lose their buoyancy and power of flight as a result. Two California murres that survived this usually fatal condition are Gus and Joe, of the Seaside Aquarium, Oregon. Mr. George P. Smith, owner of the aquarium, has rescued many such unfortunate sea birds from the beach, cleaned their feathers with castor oil, then liberated them. Gus and Joe have stayed and apparently feel quite at home either in their tank or following their savior about the premises. Gus has been there for nearly ten years and Joe for four.

One of the most interesting of the murres' natural enemies on the Pribilof Islands is the Pribilof blue fox. These foxes, which inhabit the three largest islands of the group, force the murres to nest only on the inaccessible faces of cliffs. I noticed one day, soon after the egg-laying season began in early July, a scattering of broken murre eggshells near the edges of the cliff. At first I thought that a human marauder had placed them there. Later I noticed that they were nearly always located near fox trails or dens. On several occasions I watched foxes as they crept along ledges, seemingly too narrow for even their slender bodies, searching every likely spot for eggs. The fox carries the egg in its mouth to the top of the cliff, there bites a hole in it, and then proceeds to lick the shell clean. The Aleuts say that it is not unusual to find the body of a fox below a nesting cliff, where a tantalizing egg had apparently led the animal beyond its better judgment.

Newly-hatched murre chicks are cagey little creatures, distinguished mainly by their large feet and loud, piercing chirp. They are no sooner free of the shell than they turn their backs on the sheer drop and instinctively press close to the wall of their narrow ledge. I wanted a young chick to photograph, so descended via rope one afternoon to a convenient ledge. I found that taking a downy chick from its mother was not an easy task. In the first place, my footing was none too solid, and in the second place the reluctant parent refused to leave her charge. Finally I pushed her forcibly from the ledge and was then able to grasp the struggling chick. Expecting that, once evicted, the old bird would stay away for a while, I gave her no second thought. But I had just started for the top of the cliff when she swished to a landing at my elbow, missing me by an inch or two and adding another gray hair to my head.

After finishing my photographic efforts, I found her still waiting and eager to reclaim her lively offspring. The chick lost no time in availing itself of the warm shelter of its mother's breast feathers.

Within a few weeks after hatching, the contour feathers grow, pushing away the down, and the young murre takes on the appearance of a miniature adult before making his long plunge to the sea below.

In spite of their hardiness and seaworthiness, few murres attempt to withstand the rigors of the Bering Sea in winter. As the winds increase in velocity in the fall, lashing the seas against the black Pribilof cliffs, the murres, both old and young, head southward toward the Aleutian chain. Sometimes the first autumn storm strikes with violence before they leave. If such a gale catches the young birds while they are leaving the cliff, great numbers perish.

Early in September I hiked from the village to a near-by nesting cliff. A cold, driving wind swept in from the west. The ledges that only a few weeks before had swarmed with a host of birds now held only a half-dozen stragglers. These cringed close to the rock wall in the face of a chilly wind. The wind had swept the mist away, and the fields of yellow poppies were now gone. The thick carpet of rye grass, undulating and shimmering in the cold northern sun, stretched back from the cliff. That night the first real fall storm of the year broke, but the murres were safely away to the south.

THE Peripatetic TOAD

The Giant Neotropical Toad provides one of the most unusual chapters in the history of man's efforts to enlist the services of wild animals

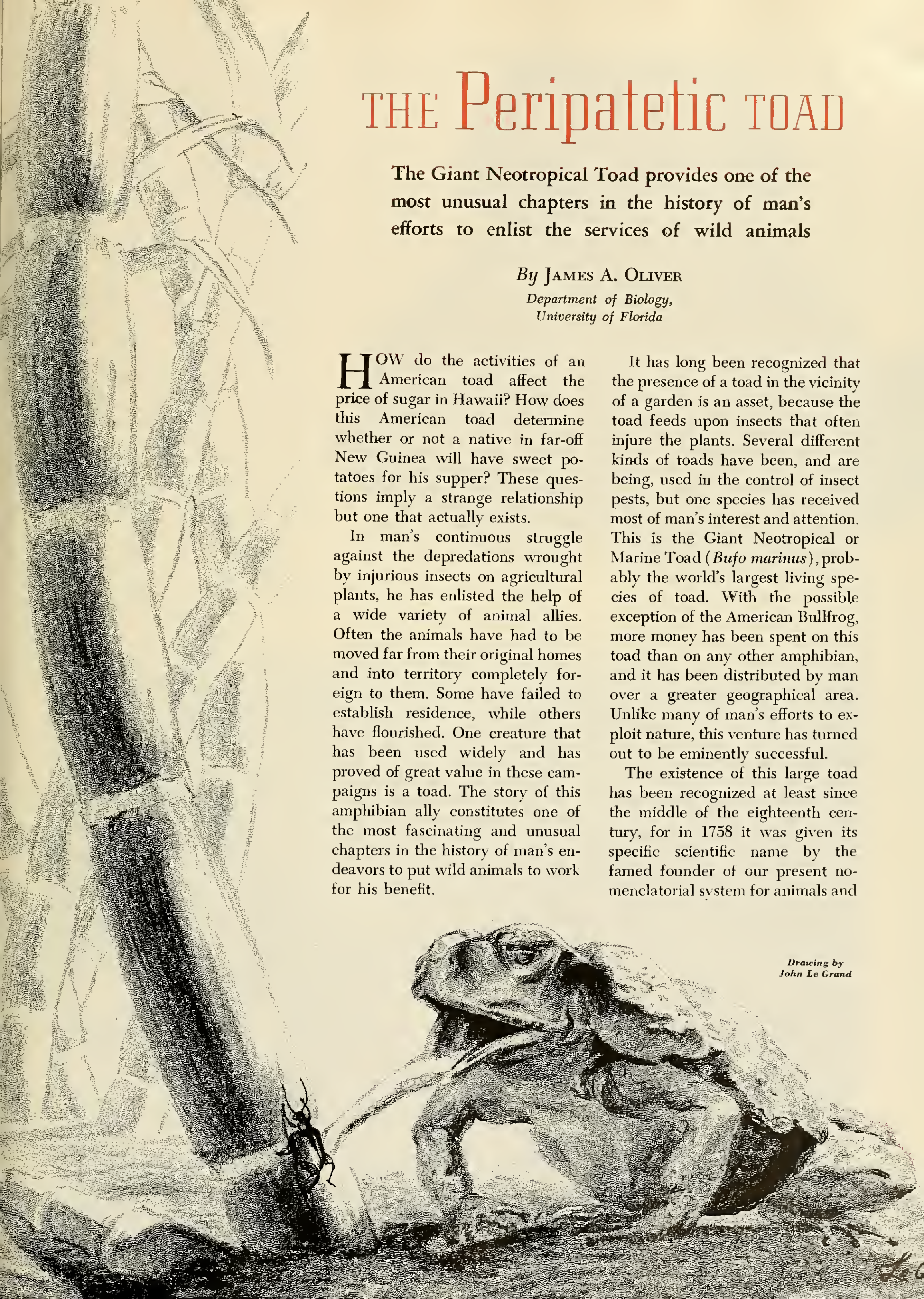
By James A. Oliver
Department of Biology,
University of Florida

HOW do the activities of an American toad affect the price of sugar in Hawaii? How does this American toad determine whether or not a native in far-off New Guinea will have sweet potatoes for his supper? These questions imply a strange relationship but one that actually exists.

In man's continuous struggle against the depredations wrought by injurious insects on agricultural plants, he has enlisted the help of a wide variety of animal allies. Often the animals have had to be moved far from their original homes and into territory completely foreign to them. Some have failed to establish residence, while others have flourished. One creature that has been used widely and has proved of great value in these campaigns is a toad. The story of this amphibian ally constitutes one of the most fascinating and unusual chapters in the history of man's endeavors to put wild animals to work for his benefit.

It has long been recognized that the presence of a toad in the vicinity of a garden is an asset, because the toad feeds upon insects that often injure the plants. Several different kinds of toads have been, and are being, used in the control of insect pests, but one species has received most of man's interest and attention. This is the Giant Neotropical or Marine Toad (*Bufo marinus*), probably the world's largest living species of toad. With the possible exception of the American Bullfrog, more money has been spent on this toad than on any other amphibian, and it has been distributed by man over a greater geographical area. Unlike many of man's efforts to exploit nature, this venture has turned out to be eminently successful.

The existence of this large toad has been recognized at least since the middle of the eighteenth century, for in 1758 it was given its specific scientific name by the famed founder of our present nomenclatorial system for animals and



Drawing by John Le Grand

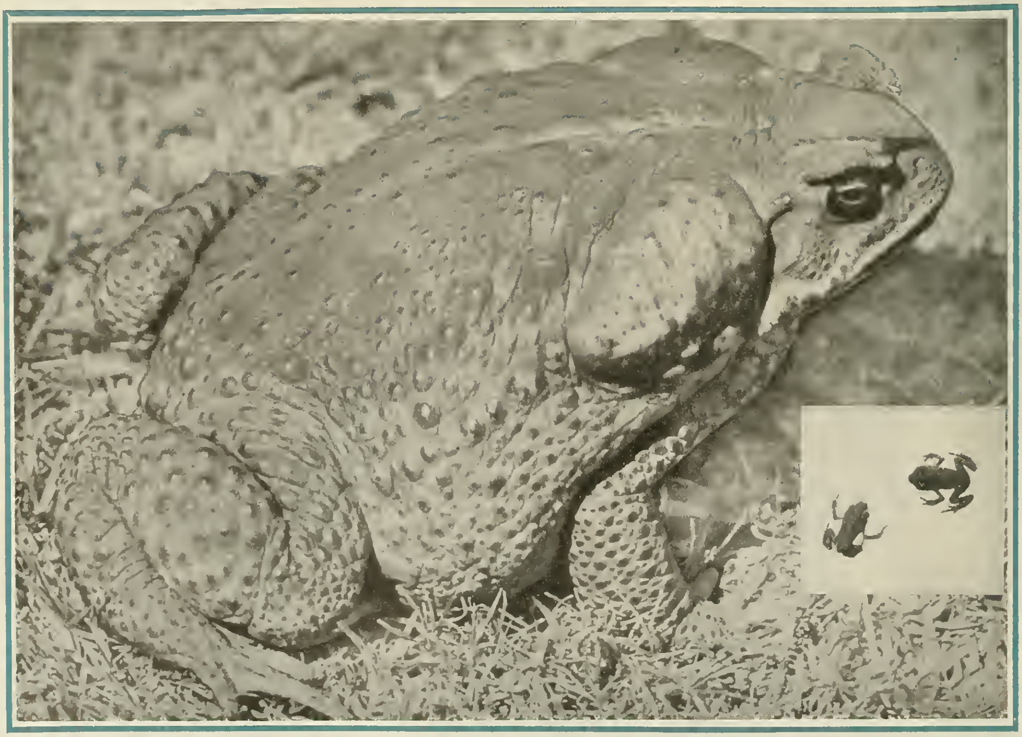
plants, Carolus Linnaeus. Prior to man's meddling with the toad, it inhabited the warm subtropical and tropical areas of mainland America from the extreme southern portion of Texas to northern Argentina. It was absent from the West Indies except on such continental islands as Trinidad and Tobago. Early in the nineteenth century, the planters of the West Indies became aware of this giant among toads and believed it might be a desirable addition to the islands. At some unrecorded date prior to 1844, a number of adult toads were transported from French Guiana to the island of Martinique and liberated there. This appears to be the earliest reported introduction of the animal, although the exact year is not known. From Martinique, the toads were carried to the British West Indies, and they ultimately reached virtually every island in this area where agriculture is of importance.

The presence of the Giant Toad in the West Indies reputedly resulted in a marked decrease in the numbers of many of the noxious insects. Scientists of the Hawaiian Sugar Planters' Association eagerly studied reports on its excellent performance in reducing the white grub pest of sugar cane in Puerto Rico. By 1932, they were convinced of its value, and Mr. C. E. Pemberton, the entomologist in charge of the study, traveled to Puerto Rico to obtain some of the toads for introduction into the Hawaiian Islands. Mr. Pemberton gathered 148 adult toads, packed them in his suitcase, and hustled them off to Honolulu by airplane. The animals were released at two localities on the island of Oahu. Here they increased rapidly, and in a little over two years, more than 100,000 descendants of the original 148 toads were distributed to various localities in the Hawaiian Islands. Other descendants of the original immigrants have now been carried throughout the Pacific area as far as Formosa, the Philippines, New Guinea, and Australia. Reports from all of these regions attest to the effectiveness of the toad in curtailing the activities of the important insect pests of sugar cane and other crops.

Toads are well suited to help man in his fight against the injurious insects, because they are not restricted to wet situations as are many amphibians and because, unlike most insectivorous birds, they feed at night when many insects are abroad. The Giant Toad was selected chiefly because of its large size. The females grow larger than the males, and the largest one I know of is a specimen from British Guiana that has a head and body length of nine inches, not including the enlarged hind legs. This is equal to the maximum size reported for the Asiatic Toad (*Bufo bufo gargarizans*) and makes these two species the outstanding contenders for the title of "largest toad

▼ An adult, sixteen and one-half months old, compared with three-day-old toads. This represents an increase in weight by nearly 5000 times

Photo courtesy C. E. Pemberton and The Hawaiian Planters' Record



in the world." A specimen with a length of seven to nine inches would fit snugly into the crown of a man's hat! Size is a useful quality for a predator of insect pests, because the larger the toad the more insects and the larger insects it can consume. An investigator in the Hawaiian Islands raised some toads from a size of less than one inch to a length of six inches in sixteen and one-half months. During this time, each toad was estimated to have eaten 1500 to 2000 insects of various sorts. A toad of such large bulk also has fewer enemies than the smaller forms.

The earliest experiments in the use of this toad were apparently casual ventures conducted by trial-and-error methods. But in recent years, careful scientific investigations have been made into the habits, life history, and best methods of raising this creature. As a result, there is now a rather extensive knowledge of the Giant Neotropical Toad, much of it to be found in the agricultural journals of tropical countries.

Where air temperatures are sufficiently high and rainfall adequate, the toads reproduce throughout the year. In other localities, the breeding season usually coincides with the rainy season. When breeding, the sexes congregate in pools of quiet water. The eggs, numbering as high as 10,000 per female, are laid in long, ropelike, gelatinous masses in the water. In two to four days, depending on the temperature of the water, the eggs hatch, and a small black tadpole emerges. The time required for development in the tadpole stage varies considerably from place to place, depending upon the temperature of the water, the amount and type of food available, the amount of light, and probably the number of tadpoles present. The shortest tadpole stage seems to occur in Fiji, where it lasts from 23 to 24 days. In the Hawaiian Islands, the tadpole stage was found to average about 30 days in the wild, but it was shortened to 25 days when the tadpoles were reared in a hatchery and fed a diet of specially prepared food. In Puerto Rico, a tadpole stage of two months has been reported. The normal food of the tadpoles during development consists of algae and the minute animals and plants associated with it.

When the development of the tadpole is completed, the animal transforms from an aquatic, streamlined form into a small toad measuring only about one-quarter of an inch in length. It remains in the vicinity of the water for several days, eating small ants and other tiny insects. After a brief period of adjustment to the new mode of living, the small toad may wander a considerable distance from any water and not return again except to perform the nuptial rites required of a mature individual. Growth is rapid following transformation, and within three months the toad may reach a length of two and one-half to three inches. Sexual maturity is attained at a size of four to six inches, when the toad is about one year old.

When man has introduced the Giant Toad to assist him in his fight against his insect enemies, he has usually been sufficiently interested in his ally's welfare to assist and protect it during the hazardous period of early development. To do this, he has established hatcheries for the rearing of the tadpoles and has even tried to get the adult toads to breed within the confines of specially constructed enclosures. Up to the present time, no large scale success has been achieved in getting the toads to lay their eggs in captivity. Therefore, the newly laid eggs are usually collected from breeding sites in the wild and brought into the hatcheries. The eggs are placed in large containers of water until they hatch, and the tadpoles are then removed and placed in large pans sunk into the ground. A steady flow of water through the pans is necessary. Here the tadpoles are fed on an artificial diet of mixed food until they transform into young toads and leave the water. The newly transformed

Photo by C. M. Breder, Jr.

▲ THE GIANT NEOTROPICAL TOAD is big enough to fill a man's hat and is probably the world's largest toad. Its appetite for insects has saved sugar planters and others untold sums toads are placed in large pens and fed on a diet of small ants.

The Hawaiian Sugar Planters' Association distributes the young toads when they are several days old. They are packed for transportation in moist excelsior or moss, in a strong container that will not crush in transit, and shipped by mail to various parts of the islands. In the Fiji Islands, the tadpoles, rather than the young toads, are usually transported to the desired localities, a method that reduces the cost of rearing them to the toadlet stage but probably involves greater losses among the tadpoles introduced.

Of course, climatic factors limit the geographical extent of the toad's usefulness. Sometime prior to 1944, the United States Sugar Corporation introduced some of these toads to Clewiston, Florida, from Puerto Rico. This experiment was unsuccessful, apparently because they were unable to withstand the cold. Just what the latitudinal limits are I have been unable to ascertain, but a creature adapted to a tropical or subtropical environment like the Giant Neotropical Toad cannot be expected to thrive in northerly regions.

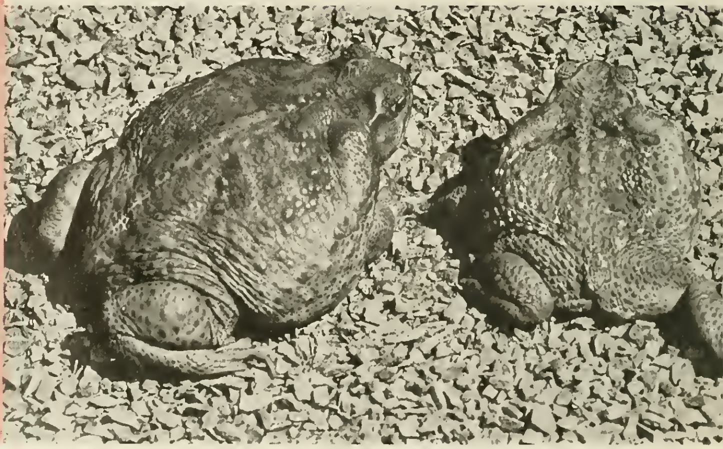
In recent years all of the new introductions of the toad have been for the purpose of controlling insect pests, primarily those of sugar cane. However, this toad was originally shipped abroad for quite a different reason. The renowned naturalist, Philip Henry Gosse, tells us that the Giant Toad was introduced into Jamaica in 1844 for the purpose of destroying rats. The Jamaican stock was obtained from Barbados, where the species had attained quite a reputation among the planters for destroying young rats.

The toad is no specialist in its feeding habits. It has a ravenous appetite and will attempt to gulp down any moving object not too large for it to cope with. Sometimes its appetite gets the better of it and it seizes an animal too large to swallow, only to have to release it after a futile struggle. The toad's diet includes, in addition to insects, such animals as snails, slugs, scorpions, spiders, millipedes, centipedes, earthworms, and even small vertebrate animals. However, insects are the principal source of its sustenance. If an abundant supply of insects is available, the toad will stop eating only when gorged to the point of distending its body.

The toad sets forth in search of its food after sundown. Several individuals may gather where insects are numerous, and often they will return regularly to the same location. In Mexico I have seen a number of these toads congregating night after night to devour the many insects attracted to a street light. Any insect that can be caught is eligible for consumption. The animal makes no distinction, of course, between those that are

Photo courtesy C. E. Pemberton and The Hawaiian Planters' Record

A HATCHERY in Hawaii, where toads are hatched for distribution in needy areas



THOUGH UNLOVELY in appearance, *Bufo marinus* has proved itself a boon to humanity and should be allowed to live its life undisturbed beneficial and those that may be harmful to man's interests, but the vast majority of the food found in toad stomachs consists of destructive insects. Thus the toad's services are eagerly sought by planters and entomologists concerned with the control of pest species. Possibly the preponderance of harmful insects in the toad's diet is due to their greater local abundance or greater accessibility.

There are, of course, exceptions to the good services performed by the toads. For example, where beehives are placed only a few inches off the ground, the toads quickly recognize an easily available source of food and congregate in large numbers to gulp down the bees as they alight to enter the hive. The stings of the bees do not seem to deter them at all. The bees can be protected by raising the hives several feet above the ground or by placing a low wire fence around them. Other objections have been raised from time to time against the importation of the toads, but most of them have vanished when the toad has had opportunity to prove its worth. The noise of a large group of males calling during the breeding season may be a nuisance when it occurs near houses. It is reported that an undesirable evening serenade was effectively silenced in Puerto Rico by placing a low wire fence around all ponds near human habitations, since the males call only when in or near water. Nevertheless, it would be unwise to fence off all ponds, because the toads must have access to water in order to lay their eggs.

When first established in the Hawaiian Islands, the frequent occurrence of these huge toads on the highways during warm, rainy nights constituted a minor driving hazard until people became accustomed to them. Dog lovers offered additional complaints; pet dogs became violently ill and occasionally died after biting a toad. Like their masters, however, the dogs quickly adjusted to the toad and learned that it would cause them no harm if left strictly alone. The illness of the dogs was caused by a highly toxic secretion from two large glands situated on the skin of the back, just behind the eyes. This secretion protects the toad from many would-be assailants who see the toad as a potential meal.

It should be pointed out that the toxic secretion of the enlarged skin glands is used solely for defense and is secreted only when the toad is seized. The effectiveness of this device is illustrated by an observation made by Dr. Albert P. Blair. He placed a female Giant Toad in a small pond. While it was swimming, a turtle seized it and tried to pull it under water. The toad inflated its body so that it floated high in the water, making the turtle's attack more difficult. The turtle finally succeeded in pulling the toad under. However, the toad soon reappeared on the surface and swam unmolested to shore. The turtle was seen swimming in the opposite direction. Examination of the toad revealed that the gland on the side that the turtle had grabbed was thickly covered with a white secretion, while the gland on the opposite side showed no secretion. Dr. Blair concluded that the secretion alone was responsible for the toad's release.

The toxicity of the glandular secretion caused concern among the poultrymen of Australia when the toad was first introduced into that country. It was feared that chickens might become sick and die from eating the toads or from drinking water with which the toads might have had contact. To determine the validity of these fears, the Australian Government conducted a number of experiments. All fear was removed when one of the chickens in the experiment consumed 142 small toads in an hour's time without showing any visible effects!

I can find no recent testimonials relating to the value of the Giant Toad in controlling rats, as suggested by Gosse's account for Jamaica and Barbados. It is doubtful that the toad regularly preys on rodents. There are, on the other hand, many statements attesting its value in the control of injurious insects. It has been of importance not only in curtailing insects that affect sugar cane but others as well, and in at least two localities it has proved of value in decreasing the number of undesirable millipedes, snails, and slugs.

For a number of years it was impossible to raise a crop of sweet potatoes in some parts of New Guinea because of the depredations of a cutworm. Only small areas could be cultivated with repeated dusting and hand-picking of the insect larvae. Then the Giant Toad appeared on the scene in February, 1937, and by the end of that year the attacks of the cutworms had ceased on the lawns of residences. The following year an excellent crop of sweet potatoes was produced. Did the presence of the toad really have some bearing on the reduction of the cutworm, or were the two merely coincidental? The finding of 110 cutworms in the stomach of one adult toad leaves little doubt.

In Jamaica, one study revealed that, in addition to a large number of harmful sugar cane pests, the average toad contained about ten destructive banana borers. In the Hawaiian Islands, large numbers of harmful rose beetles and Surinam roaches have been found in the stomachs of the toads. The roach is of serious concern to poultrymen because it is the intermediate host of the eye worm of chickens. Indeed, the list of harmful insects destroyed by this toad is far too long to list here, and its influence is felt far beyond the price of sugar in Hawaii and the yield of potatoes in New Guinea.

Science, with its increasing rate of progress, will undoubtedly provide a more effective and more economical means of curtailing or ending completely the ravages of insect pests on agricultural crops. What does the future hold for the toad that man has carried almost around the world? How will man acknowledge his gratitude for the services of his warty assistant? Let us hope that this large toad will be allowed to wander as a recognized friend and search unmolested for whatever food it can find in the gardens, fields, and uncultivated areas of man's domain.

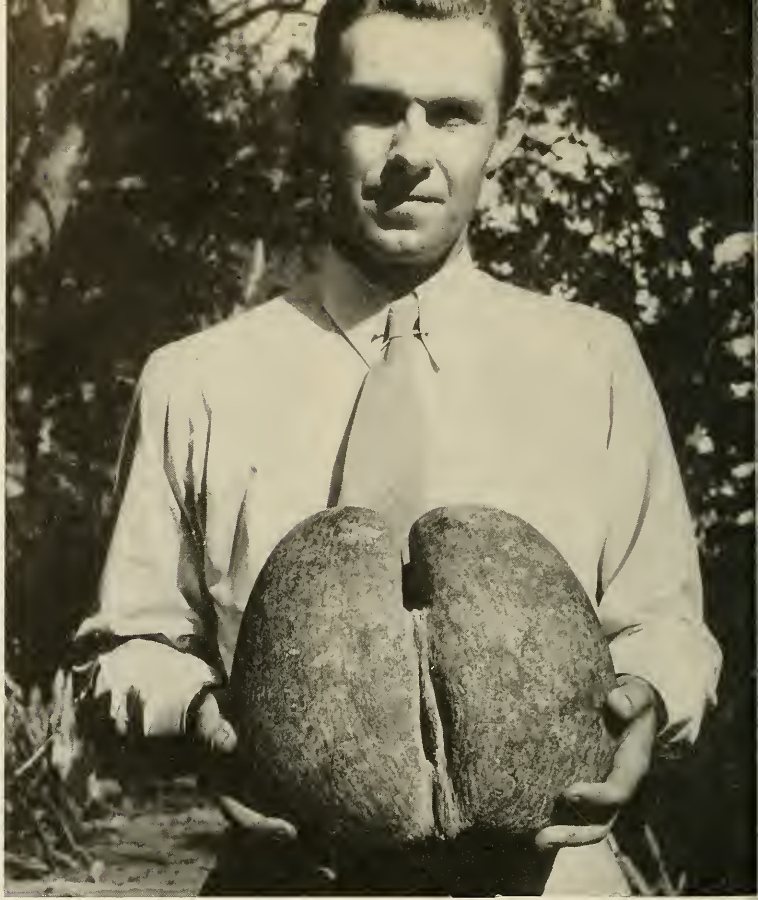


Photo by Hugo Schroder

The Goliath of Seeds

The largest seed that grows was shrouded in mystery until its island home was finally determined

By Walter Henricks Hodge

HOW BIG IS THE BIGGEST?

RESIDENTS of temperate climes are generally unfamiliar with large seeds. When we plant our garden vegetables, we know that a handful of average-sized vegetable seed should suffice for a row or two. In comparison, a horse-chestnut seed is really something to marvel at, as is shown by their popularity among small boys. Yet the seed of the horse chestnut is a puny thing compared to a coconut, and a coconut in turn is puny, too, when set down beside a Seychelles nut, or coco de mer. For the Seychelles nut is the largest true seed that grows and is to the plant world what an ostrich egg is to the animal world. In short, it is the Goliath of all seeds.

For centuries prior to about 1600, gigantic hard-shelled nuts, two or three times the size of an average coconut, were sometimes found washed up upon the shores of India and other lands bounding the Indian Ocean. These enormous seeds looked like oversized coconuts, yet no one knew their origin other than that they were brought in by the sea, and so in this way the name coco de mer (sea coconut) fell upon them. Such marvelous flotsam was rare and, as was common in those days, its rarity was supposed to give it wonderful virtues.

At first, people were not sure whether the great floating objects were plants, animals, or minerals. Before long, and typical of the times, a number of wild tales had been invented to explain the source of these sea-deposited objects. One had it that the nuts grew on submerged trees near the island of Java. Yarn-spinning sailors reported that on diving to pick these undersea seeds, the trees would mysteriously disappear. Another story related that in certain parts of the tropical ocean the trees, growing above the surface of the water, harbored a griffin, or vulture-like bird, which was accustomed to fly to the nearest land, where it fed, of all things, on tigers, elephants, and rhinoceroses! Unwary sailors were also devoured by the flying monster if their ships were inadvertently drawn in by the giant waves that, supposedly, surrounded the tree at all times.

Seeds obtainable only after passing such hazards must certainly be as valuable as the mythological golden apples. It is little wonder, then, that kings and other potentates of the Orient coveted the strange nuts and even passed decrees that these peculiar objects could be acquired only by persons of high rank. Apparently the nut's chief virtue was as an antidote to poison, and in a day when royalty was under constant threat of poisoning, the possession of a coco de mer was almost a necessity for a successful and continued rule. Obviously, no sum was too large to pay when a charmed life itself could be thus ensured. In those days the nuts must have been hollowed out to form tight receptacles, for it was believed that poison, however violent, would be ineffective when added to water that had been stored in one of these containers. As the coco de mer became more widely known, it grew in virtue to such a degree that it came to be considered a general panacea, which accounts for the new name, *nux medica,* which was given it in the sixteenth century.

All the aura of mystery that veiled the coco de mer in its early contacts with civilized man was finally lifted in the middle of the eighteenth century. About that time Praslin Island, one of the 29 islands included in the Seychelles group (lying in the Indian Ocean northeast of Madagascar) was discovered, and in its extensive forests of palms was found a curious species of palm (*Lodoicea maldivica*) bearing a giant nut. The source of the coco de mer was at last known.

Despite inroads by agriculturists and curiosity-seekers, groves of *Lodoicea* are still to be seen on this tiny isle of palms. The trees love their own company and form extensive colonies on the slopes and intervening valleys. Like many another interesting palm, it has wandered at man's behest far from its home, and quite a few distant tropical gardens—a number of them in our own hemisphere—can boast living specimens of this famous species.

The Seychelles nut palm is oversized not only in its seed but in most other respects. The straight, tough trunk, said to be "as upright and unyielding as an iron pillar," sometimes attains a height of 90 feet and bears at its summit giant, rigid, fan-shaped leaves that often measure 25 feet from the tip to the base of the leaf stalk. A peculiarity of the palm is a queer protective, socket-like bowl into which the bulbous base of the trunk snugly fits. As tough as the hard shell of the nut and apparently made of the same substance, the curious bowl is extremely resistant to decay, and half a century or more after one of these palms has been cut down, its socket may be found perfect in every respect.

HE HUGE Seychelles nut resembles a coconut some ways. But it weighs upwards of 40 nds, and its "meat" becomes as hard as etable ivory

▼ SECTION through a dehusked Seychelles nut, showing the peculiar two-lobed design

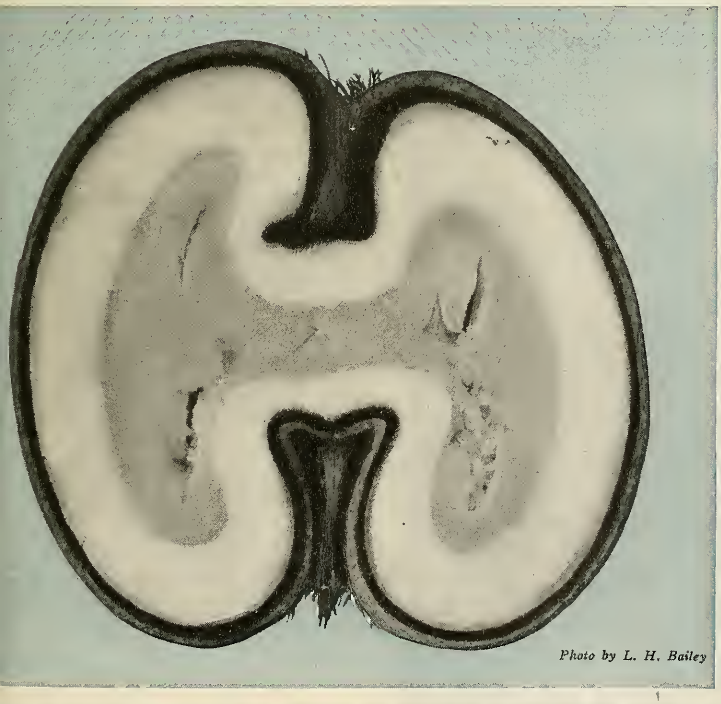


Photo by L. H. Bailey

Photo by L. H. Bailey

▲ YOUNG at 40 years: a male Seychelles nut tree growing in Jamaica. It is not yet old enough to have a true trunk

But today, as in the past, it is the fruit that is the most spectacular feature of *Lodoicea.* In its homeland a female palm usually attains an age of at least 30 years before it produces its first crop of nuts, and even then the tree is hardly out of its youth and may not yet possess a true trunk. Clusters of the great nuts, which require about five years to mature, resemble somewhat the common coconut in all except size (a single coco de mer may weigh upwards of forty pounds!), for they have a similar smooth, tough outer coat or husk which overlies the same sort of fibrous layer that one associates with the coconut bought at the corner market. The big difference lies under the smooth outer husk, for the giant Seychelles nut is, unlike a coconut, bilobed, a fact accounting for the misnomer "double coconut" often met with in discussions of this palm. In its youth the jelly-like interior, or endosperm, is edible like that of a green coconut, but at maturity most of it is as hard as vegetable ivory. The edibility of this bizarre nut may thus be transient but not its fame, which firmly rests on its size, making it the Goliath of all seeds.

Living Lamps

The mystery of the firefly is but one facet of an astonishing spectacle to be observed in widely varying forms throughout the plant and animal kingdom

By N. J. Berrill
McGill University

THERE is a light of earthly origin that fades before the sun or the moon and is neither fire nor heat. It shines only in living moisture. It is the cold light of life itself, no warmer than the organism that produces it, whether in the heavy warmth of a tropical night or the icy cold of the oceanic abyss. It is a light of elfin quality akin to starlight, shining where or when no other light is seen, shining in answer to its own kind, a response of life to life.

The flashing of the firefly and the unearthly halo of the glowworm have excited the ancients and inspired the poets. Tennyson likens the rising of stars to the glitter of fireflies, while Shelley in his immortal ode to the skylark, compares its song to "a glow-worm golden in its dell of dew, scattering unbeholden its aerial hue."

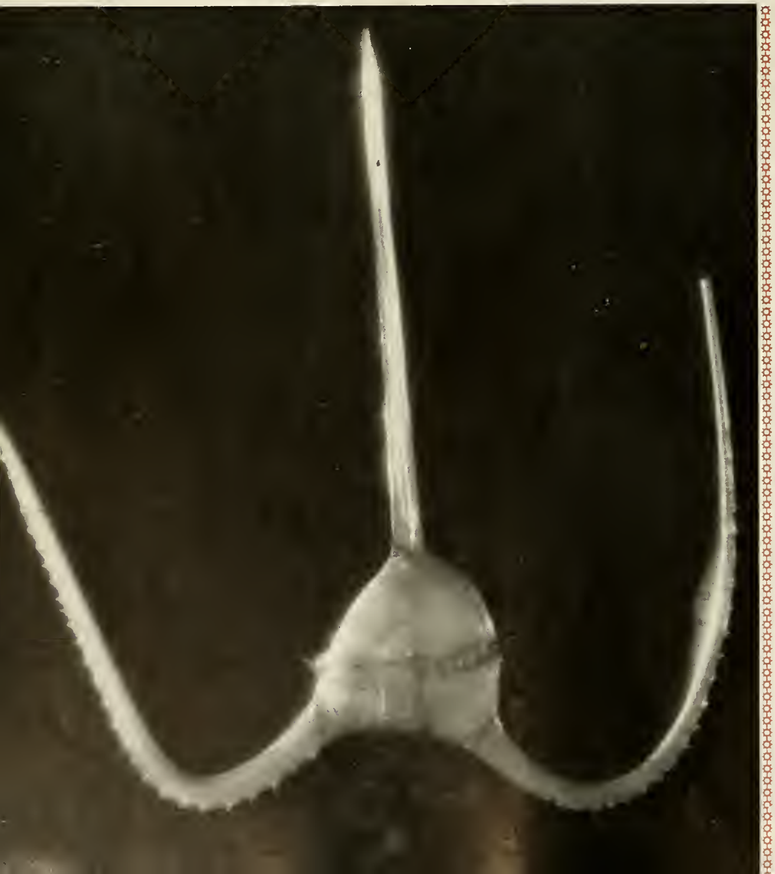
Enshrined in literature, the luminescence of animals and plants has also engrossed naturalists for the last two centuries and at the present is the subject of intensive physiological and biochemical research. In the last few decades nearly 500 scientific papers have been published concerning this phenomenon, more than 90 of which have come alone from, or in collaboration with, one man, E. Newton Harvey, whose book *Living Light* is an inspiration to contemporary biologists.

Apart from the aesthetic quality of this eerie light and the emotional response it evokes in the human mind, there is great scientific interest in it, on various levels of inquiry. There is the question of the chemical nature of the reaction that creates the light, a reaction that appears to be essentially the same wherever it is found. There is also the physiological control of the light by the animal endowed with it, and the elaborate structure that is sometimes evolved. The use that the animal makes of it offers some puzzling questions. And finally there is the riddle of why it should be found so widely scattered among distantly related animals and plants, whose closest relatives are often limited to a dull, sparkless life.

Light of living origin is known in virtually all groups of the animal kingdom and, in addition, among fungi and bacteria. Its widespread but sporadic occurrence suggests that the basic chemistry involved is closely associated with the normal activities of all living cells and that all living tissue, when not too specialized, has been and may still be on the point of making this discovery.

The greatest abundance of living light comes from microscopic organisms. Probably every voyager on

AMNH photo



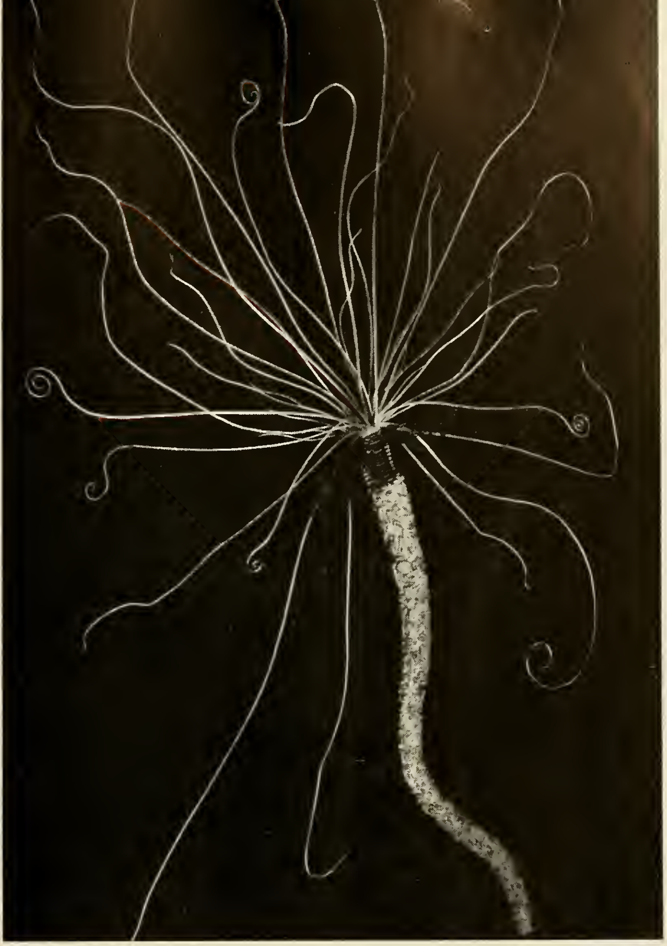
◀ **Familiar to many** is the luminescence seen in the wake of a ship or in breaking waves. Less familiar is the tiny protozoan Ceratium, one of the organisms producing this light. This is a highly enlarged glass model of the creature, painstakingly constructed from microscopic studies the high seas has at some time wondered and marveled at the phosphorescent wake of a ship on summer nights when the moon is down. This is due for the most part to the so-called armored flagellates —single-celled animals abounding in the upper layers of the seas. They range in size from Noctiluca itself, the largest and just visible to the naked eye, to minute forms one-fiftieth of a millimeter across. Many are colored, often pink, and they may occur in such numbers as to make the sea a soup. The reddish color of the Red Sea is due to these organisms; and one of the smaller forms is responsible for the famous Fire Lake at Nassau, in the Bahamas. At night, those that are luminescent will shine when agitated, whether the disturbance be due to the hull of a ship, the passage of fishes, or the breaking of waves. Sometimes shining footprints may be left in damp sand at the edge of the receding tide by a wanderer in the dark. More closely examined, the light is seen to be made up of pin points, each corresponding to a single minute organism. A jar of sea water shaken at night may scintillate from many small flashes. Almost any kind of stimulation, in fact, causes a flash of light to spread over the little Noctiluca from two stationary spots, lighting the animal up momentarily and then going out.

A large part of living light comes, however, from luminous bacteria, and it has been found that many organisms do not have luminous tissues of their own but rather gain their luminosity from associated bacteria. The light from a single bacterium cannot be seen, it is so small, but when many of them are present they produce the glow that is sometimes seen on the body of a dead sea animal. They can easily be propagated artificially, emulsions of them giving off light, often bright enough to read by, as long as they have access to oxygen. They have even been cooled to the temperature of liquid air without losing their capacity to luminesce upon being warmed again.

The legendary fox fire of medieval England and older times is due to luminescent fungi, molds infecting rotting wood and leaves. They are common on the wooden supports in coal mines. In both fungi and bacteria the production of light is continuous and independent of any external stimulation, unlike the flashing or intermittent light of animals.

Luminescence is widespread among the coelenterates, which embrace such diverse forms as jellyfish, anemones, corals, hydroids, and others. Some of these glow more beautifully than perhaps any other creature. Since the time of Pliny, jellyfish or medusae have been known to give off light. One of the most striking is the large Mediterranean *Pelagia noctiluca,* whose name means "luminous swimmer of the night." The larger flashes of light in the sea seen from ships are probably due to such as this. When a part of the jellyfish is touched, a luminous spot appears and may spread until the whole outer surface is involved, including the tentacles. A luminous slime is produced which is liable to stick to a person's hands.

Animals related to jellyfish but having a very different appearance and habits are the sea pens and sea pansies. These are composite or colonial organisms consisting of many individuals united together to form a greater whole and an-



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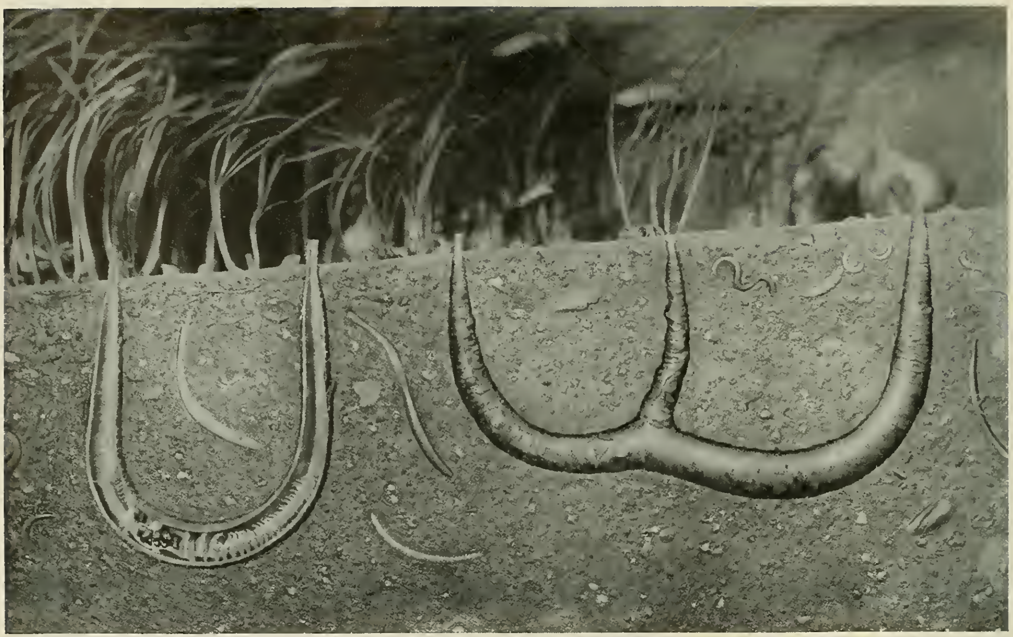
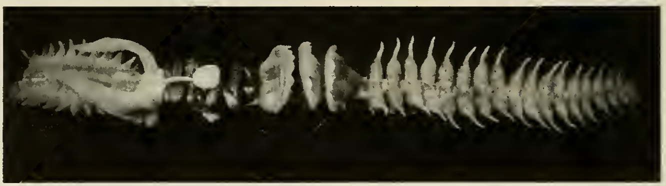
▲ A LUMINESCENT TUBE-BUILDING WORM [*Polymnia* (*Terebella*) *magnifica*] from the Bahamas. The body of the worm lies encased, while the long, fine tentacles form a trap for small animals upon which the worm feeds



AMNH photos

▲ A WORM THAT HIDES ITS LIGHT: the parchment worm (*Chaetopterus pergamentaceus*). Why a creature that lies completely buried in its tube in the sea bottom should be strongly luminescent remains a riddle



▲ THE PARCHMENT WORM ENLARGED. It lives on tiny food organisms which it propels through the tube by action of the fanlike equipment located in the middle section

chored in the mud on the sea floor by a stalk. The sea pansy of the Atlantic coast has the shape and size of a pansy and shines at night with a clear blue-green or golden-green diffuse light rippling over its surface. Sea pens and a gorgonian sea rod taken from considerable depths often glow with a pale violet light. One of the sea pens, which during the day lies as a tough, turgid mass in the sand on the bottom of fiords in Japan, at night becomes tall and erect and produces a brightly luminous slime from the whole of its outer surface, similar to the jellyfish.

Another group of somewhat lowly sea animals, some of whose members exhibit luminescence to a marked extent, are the marine worms. Light is produced by members of several families. Two of these, the cirratulids and terebellids, are alike in certain ways. In both, the body of the worm lies buried or encased in mud, sand, or crevasses, while long, fine tentacles writhe over the adjacent sea floor to form a trap for any small animal that may make a false step. Some of these worms, if agitated, send ripples of violet light out from the base along each of the tentacles. Whether this property increases the efficiency of the food trap or is merely a tolerated quality, no one knows.

Even more mysterious is a fantastic worm called Chaetopterus. It lives in a parchment tube of its own making, which is for the most part buried but has two open ends projecting a little above the sea floor. The worm lies completely within the tube, its forward region forming a trap for tiny food organisms. The middle region has fanlike equipment for creating a strong current of water, and the hind part is mainly reproductive. The animal cannot be seen within its tube; it has nothing to gain and much to lose by emerging even to a limited extent, and yet it is strongly luminous. Worms are exceedingly vulnerable, and the luminescence of Chaetopterus raises the suspicion that this animal is safely luminous only because it is safely hidden, its light being an ornament to its career and of no useful value.

In the case of the fireworm, Odontosyllis, however, there is no doubt that the light is usefully employed. During summer months, in the intervals of complete darkness between sunset and moonrise, the worms rise to the surface to mate. The females reach the surface and liberate eggs, becoming brightly luminescent all over. The males swim toward the females but exhibit only a slight luminescence at the head end. The males will swim toward any small light at this time, and there is no doubt that the female's brightness serves a purpose.

But among the mollusks we again find the paradox of luminosity that has no conceivable value to its possessor. The rock clam, Pholas, is a fairly typical clam common in the Mediterranean. It lives in mud or soft rock and does not move around; it cannot see, and at best it can merely extend its neck or water siphon a little beyond its burrow. It feeds by a continuous inhaling of a current of water, from which the tiniest and most helpless microorganisms are mechanically filtered out as food. Yet the animal is intensely luminous and has a special gland under nervous control for the production of the luminous slime. Is the light merely a tolerated incidental acquisition, or is it employed in some obscure way to aid in the acquisition and sorting of food? Some of the oldest experiments with luminous material from living organisms have been made with this creature. More than two centuries ago it was found that if flour paste or honey were added to the luminous material, it would give light when water was added, even after a year.

Exploitation of luminescence among sea animals has been carried farthest by the two groups that seem to be competitive in most other ways as well—the squids, among the mollusks, and the fishes. Squids and octopuses are fantastic creatures, especially when compared with their molluscan relatives such as the oysters and snails. There is evidence that they possess more than a degree of intelligence and may become afflicted by fear and anger. It is not surprising, then, that the greatest use of living light has been made by those animals that have the better developed eyes and brains. There is a possibility that some squids employ luminous bacteria, but it is more likely that in most cases the light is manufactured by the squid's own tissues. One of the smaller deep-water squids of the Mediterranean, Heteroteuthis, which lives in the dark far below the twilight zone, is unique. When a more ordinary squid is disturbed in shallow water, a dark cloud of sepia pigment emerges from its ink sac, forming either a smoke screen or a decoy that enables it to escape its enemies. In the dark depths, such a device could obviously have little value. Heteroteuthis, however, while retaining a small ink sac (that it possibly never uses), has evolved a large gland just in front of it, which produces a bright luminous secretion. It shoots this substance out into the surrounding water and envelops itself in a cloud of cold liquid fire.

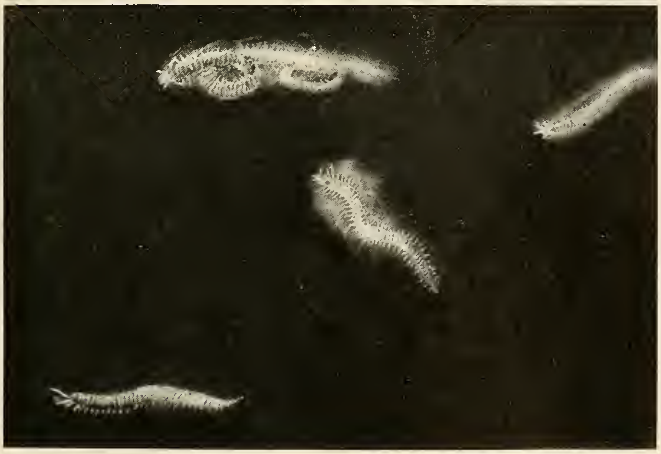
Other squids are luminous in a very different way. Their light is manufactured in small organs scattered over various parts of the body. A small squid taken in the Indian Ocean at a depth of nearly two miles had, near the eye, jewel-like luminous organs that were ultramarine-blue. In addition it had pearly-white lateral organs, ruby-red ones on the tentacles, and sky-blue lights on the lower part of the body. The light is not extruded as a slime as in so many other forms but is produced within small, closed, spherical organs built somewhat along the lines of a bull's-eye flashlight.

Most deep-sea squids can be obtained only with great difficulty and are consequently very rarely

AMNH photo

▲ THE JEWELFISHES (*myctophids*) flash their luminescence far down in the sea, where the last feeble light merges into blackness

AMNH photo of drawing by Grace White



▲ THE MARINE FIREWORM, *Odontosyllis,* employs its light usefully. The females become brightly luminescent when they rise to the surface at night to liberate their eggs, and the males are thus attracted to them

AMNH photo

A Luminescent lures at the ends of "fishing rods" contribute to the grotesque appearance of these small Oceanic Anglers

studied. An exception is the firefly squid of Japan, which has been studied alive intensively by a number of Japanese biologists. This squid is caught in immense numbers on the west coast of Japan in the spring and early summer, for use as fertilizer in the rice fields. The luminescence is bluish, but again there are several kinds of organs, variously located. The largest and brightest are on the arms; medium ones are located below the eyes; and minute organs are scattered over the ventral surface. These last differ in the two sexes and possibly serve for sex recognition, since the animals are caught during their breeding migration.

Luminous fishes are perhaps better known than other luminous forms from the sea. Some come from the dark, abyssal waters of the oceans; more are found in moderately deep water in the twilight zone, that region in which there is still a lingering trace of the penetrating surface light. The true deep-sea fishes generally have rows of luminous organs like those of the squids, the organ itself manufacturing light that shines through a kind of lens. A similar fish that comes into shallow water to breed is the singing fish of California, which may have nearly 800 light organs along its sides. On the other hand, certain fishes of the East Indies are luminous but are not in any sense deep-sea forms. In these there is a large white organ beneath the eye, which the fish can conceal at times. In one, a black screen of skin is drawn up over the organ to obscure it; in the other, the organ is hinged and can be turned down into a pocket. The reason for these arrangements is that the light itself is not produced by the fish and is not under its control but results from the activity of bacteria contained and growing in the organ. Bacteria produce light continuously, hence the need of a shutter mechanism if the fish is to make good use of it. There is no doubt that the light is used by the fish to attract its prey, and the islanders of the region cut out the light organ and use it for bait while fishing.

Shrimps and prawns have evolved both kinds of light organs formed in other groups. Some have a gland that produces a luminous slime which the animal can eject. Others have lantern-like organs similar to those of the squids and deep-water fishes. They flash these under control as they migrate more than 1000 feet up and down every day.

Another crustacean, though much smaller, is an ostracod known as Cypridina and also as the marine firefly of Japan. It is only about one-eighth of an inch across and is usually caught feeding on fish heads used as bait. Near the mouth the animal has a gland that is very large for its size, and this produces the luminous secretion, bright bluish in color. The main interest in this form is its value in connection with chemical investigations into the nature of the light reaction. When dried, Cypridina can be stored almost indefinitely, only to become brilliantly luminous again when wet, even after more than 20 years. The reaction is therefore not essentially a "living" reaction, insofar as it survives the death of the organism. In itself it is not dependent upon living cells, although they are necessary in the stages of preparation. On the other hand, oxygen is necessary, although only a very small amount is essential. In its absence, luminescence ceases. Carbon dioxide apparently is not produced.

Experiments made in the last part of the nineteenth century showed that if a cold-water extract of a luminous tissue is mixed with a cooled hot-water extract after both had been left standing until all light had disappeared, light is again produced. The substance extracted by the hot water and not destroyed by it was called *luciferin.* The substance extracted by the cold water and destroyed by heat was called *luciferase* and was considered to be an enzyme or ferment. When the two are brought together, light results. This concept and these terms are still the basis of present interpretations, even though only 5 out of 21 of the different animals tested by Harvey demonstrated the luciferin-luciferase reaction. In Cypridina, luciferin and luciferase occur as granules in long, separate gland cells opening at pores near the mouth, and they come together only upon extrusion from the gland as a whole.

The nature of luciferin and luciferase and of their mutual reaction is now the subject of biochemical research, already at an advanced and complex stage. There are, however, some facts of general interest. One part of Cypridina luciferin in 40 billion parts of water can luminesce sufficiently for the human eye to detect. Luciferin has a small molecule and is not a protein. At the same time, there is a specificity that is usually associated with protein nature. Only when the luciferin and luciferase of closely related forms are mixed together does luminescence occur. Extracts from Cypridina, for example, give no light when mixed with those from fireflies. Extracts from different fireflies, however, do produce light when mixed. This last is of considerable interest, for the firefly Photinus has a reddish light, while Photuris has a yellowish one. Combination experiments with extracts have shown that the color in either case comes from the animal supplying the luciferase or enzyme and not from the luciferin, indicating that the light actually comes from the enzyme molecules.

Cypridina and luminous bacteria have been used in most of the modern work on the chemistry and physics of living light. However, luminous insects have been employed for the most part in physiological studies dealing with the nature of the tissues, organs, and general mechanisms involved in the production and control of light by the animal as a whole.

Many insects are luminous, though they mostly belong to two or three orders. The famous glowworm of certain New Zealand caves* is the larva of a fly that spins a glutinous web. The glowworm of English poetry is a wingless female beetle that shines in summer nights from grassy tufts or hedgerows. The light from the lower hind part of its abdomen serves to attract males flying in the neighborhood. The Cucujo beetle of the West Indies and tropical America is even more spectacular and has been known for centuries. The adult has a pair of bright, greenish, luminous organs on the thorax and a more orange organ at the base of the abdomen on the underside, only seen when in flight. The light has been estimated as the equivalent of the brightest stars. In earlier times, natives were said to use them as candles and to collect them in large numbers in midsummer to tie to garments as ornaments during the nocturnal festivities. Girls are supposed to have tied them to their feet to illuminate the forest paths in the dark tropical night.

The railroad worm of South America, much rarer, is a beetle larva about two inches long that has astonished everyone who has seen it. It has a red light on the head and rows of greenish lights on the sides of the body which glow continuously for weeks, possibly throughout the life of the larva.

Finally, there are the fireflies (beetles belonging to the family Lampyridae)—the dancing lights of warm nights known almost the world over. Most of them are tropical, although among temperate countries North America and Japan are fortunately endowed. In Japan firefly festivals are held, the insects being bred for the purpose. Not only in the tropics but also here in the United States, many persons have seen firefly displays in which the switching on and off of the lights was synchronized throughout a colony of flies. This is one of the most spectacular sights in Siam among the trees along the river banks. The fireflies fly out of the forest at dusk and congregate around certain favored trees, to flash in close and rapid rhythm for weeks or even months at a time. All those flashing in unison are males, and the phenomenon appears to have no connection with mating.

As generally seen, however, the flashing of fireflies is a system of communication that females, usually at rest in the grass, carry on with males in flight. The male flashes, the female answers, the male flashes again in response, until the pair comes together. Every kind of firefly has its own peculiarities of flashing, which vary in color, brightness, duration, and frequency. An expert can recognize these and so identify the kind of firefly. Normally there are four types of light production: (1) a continuous glow, rare among fireflies, (2) an intermittent glow that remains relatively steady for a matter of seconds or minutes, more characteristic of larval fireflies than adults, (3) a pulsation, given off so rapidly as to produce the effect of a continuous fluctuating light, though usually with occasional periods of darkness, and (4) best known of all, the flash. This is essentially a burst of light, much brighter and shorter than occurs during a glow. Most flashing fireflies give single flashes; but certain forms produce multiple flashes which approximate the flicker-appreciation limit of the human eye.

How the firefly controls the frequency and quality of light is a problem that has attracted much attention, effort, and discussion. Several theories have been put forward, all based on an intimate knowledge of the details of structure and function of these organisms. The light organs themselves are relatively complex, differing considerably among the various species and often different even in the male, female, and larva of the same species. In fireflies and glowworms generally, however, the organ is basically comparable in structure to those of shrimps, squids, and fishes. It consists of a mass of light-producing tissue, backed on its inward side by a reflector pigment layer and covered on its outward side either by a transparent window or a layer of transparent tissue shaped to form a lens.

All in all, the very existence of living light, together with its varied and beautiful manifestations throughout the living kingdom, presents one of the most fascinating phases of the whole evolutionary epic, and it is one that will have appeal as long as there are people to observe it.

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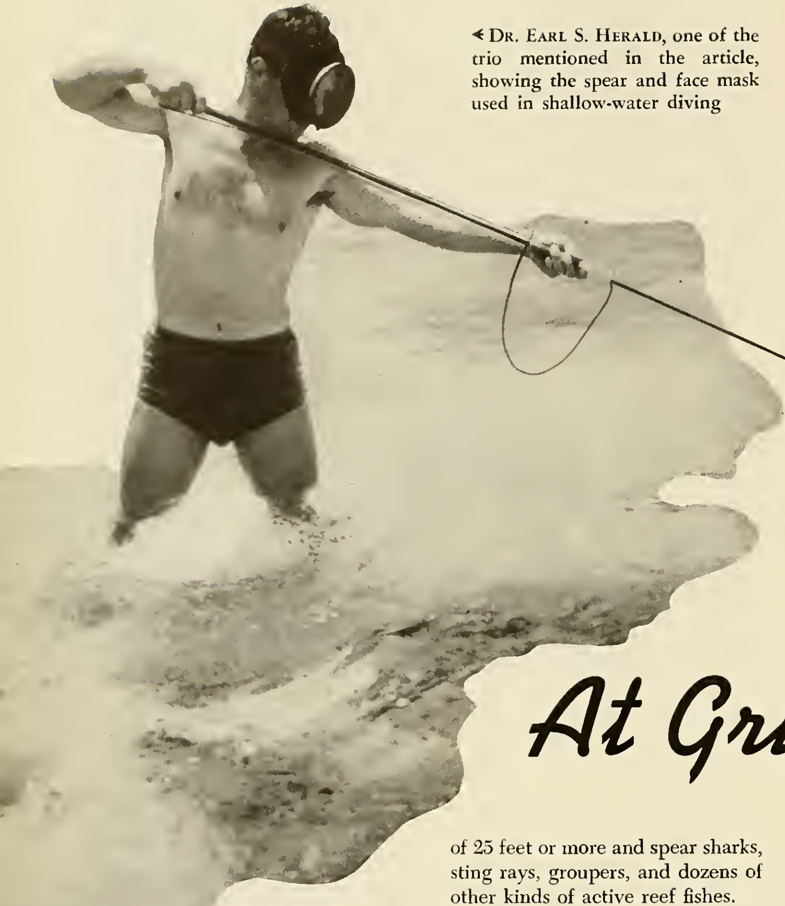
*See "Stars of Death," by Alton L. Blakeslee, NATURAL HISTORY, February, 1948.



◄ **Dr. Earl S. Herald**, one of the trio mentioned in the article, showing the spear and face mask used in shallow-water diving

A terrifying encounter beneath the waters of the Pacific

By Leonard P. Schultz

Curator of Fishes, Smithsonian Institution

At Grips with

SKIN diving and the spearing of fishes for sport is a thrilling but sometimes dangerous occupation. Even to the most experienced swimmers and ichthyologists, who know the habits of vicious fishes, accidents happen.

During the long months at Bikini waiting for the atomic bombs to explode, Vernon Brock, Earl S. Herald, and I spent a great amount of time studying the ways of fishes. Vernon Brock is Director of the Division of Fish and Game in Hawaii, and Dr. Herald is Director of the Aquarium of the California Academy of Sciences in San Francisco. Both men are excellent swimmers and could easily swim to depths of 25 feet or more and spear sharks, sting rays, groupers, and dozens of other kinds of active reef fishes.

Their equipment was simple—swim fins or flippers on the feet, face mask for seeing under water, a six-foot steel rod barbed at one end as a spear, and a rubber sling for shooting it.

Almost a One-way Dive

I will tell you of one daring feat by Mr. Brock that ended in near tragedy. On May 20, 1948, he visited Johnston Island, some 700 miles southwest of the Island of Hawaii. By motor launch he went to the northern reef, where deep channels and pools occur among the beautifully colored algae and coral reefs. Some 50 yards from the boat, he saw a large brown eel partly concealed beneath a coral ledge. Its body was 18 to 20 inches high and 12 to 14 inches thick. The length exceeded all known records of eel size—about 10 feet.

Brock says, "Once I spotted the eel, I couldn't believe it; eels don't come that big. I called over another [man] . . . to take a look. He also didn't believe it. I borrowed his spear and, diving down (the eel was about 20 feet deep), put the spear squarely through the head. The eel did not even move. I left the spot for the surface to observe the eel. Fifteen or twenty minutes passed. I returned to the eel, and in the interval mentioned no movement had occurred. Then I made a little error; I assumed that the eel was dead. I dove, picked up the spear with the transfixed eel, and returned to the surface. The eel began to move. It started directly for me. I attempted to hold it off with the spear, but the eel simply swam up to me, the spear sliding farther out the other side of the body as the eel approached. I dropped the spear and swam off by flippers at a good clip. Swimming on my back, I watched the eel come at me with great flapping. My head seemed to be the selected point of attack, for I felt the muscular body undulate savagely against mine, first at my feet, then along the right leg, then my hip and side. The eel was almost up to my face. Its tail was well beyond the tips of my flippers. I began to realize that I wanted very much to be elsewhere."

Then the eel reared high out of the water and struck downward as a snake strikes. Its mouth was a foot long, and its teeth from an inch to an inch and a half long. As it struck to engulf Brook's head, he raised his elbow to shield his face. He said, "I felt the mouth tighten convulsively on my arm. The arm felt just like an orange in an orange squeezer—crushed."

After the single bite, the eel opened its mouth and Brock's arm came free. Bleeding profusely, he then swam the 50 yards to the boat, where a tourniquet was placed on his arm. A navy doctor spent the next two and one-half hours sewing up the wounds. Then Brock was flown in a B-17 to Honolulu for further treatment, at Tripler Hospital. Three months later he had regained nearly full use of the arm, but large scars remained.

The giant eel was not recovered.

Unusually Large

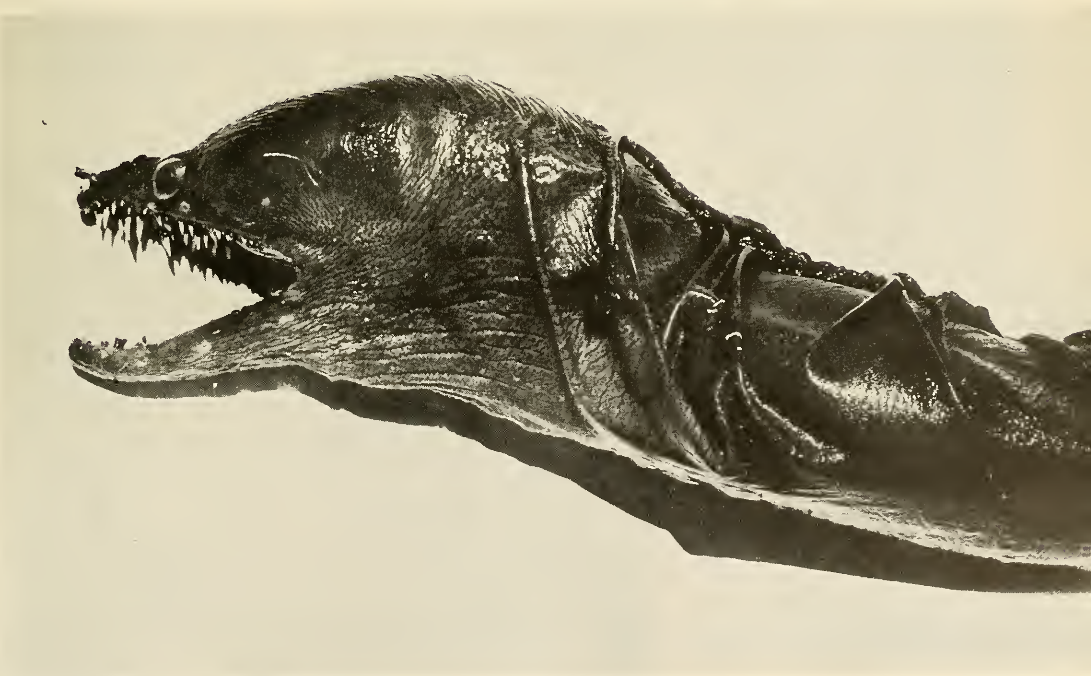
I have seen but one such large eel. That was in 1939 at Canton Island, in the Phoenix group. I had treated a lagoon coral reef with powdered cubé root, along the edge of 20-foot-deep water. Many small fishes were made ill by the chemical, which had reached the bottom. Suddenly there appeared about 50 feet from me a giant brown eel, swimming at the surface in a circle, opening and closing its nearly foot-long jaws, which were equipped with fanglike teeth. It reared up and out of the water, thus splashing again and again. The massive body was as large in diameter as my leg near the thigh. Its length was close to seven feet. Experience in the capture of many smaller ones had taught me the vicious nature of these moray eels—their willingness to come out and fight if poked or disturbed—and I considered it the better part of valor to let that eel escape, although I greatly wanted it for a specimen.

My identification of the Canton Island giant brown eel places it as a tropical Pacific species of moray —*Enchelynassa canina*. It is highly probable that the same species or a closely related one of that genus attacked Vernon Brock.

It was only the remarkable underwater skill and speed of swimming, which I have witnessed so often in Mr. Brock, that saved his life.

Giant Moray Eel

▼ THE GIANT BROWN MORAY EEL, *Enchelynassa canina*. Note the savage array of teeth



TERMITES
Desert Division of Street Cleaning

Something unexpected to look for the next time you visit the desert

By Lewis Wayne Walker

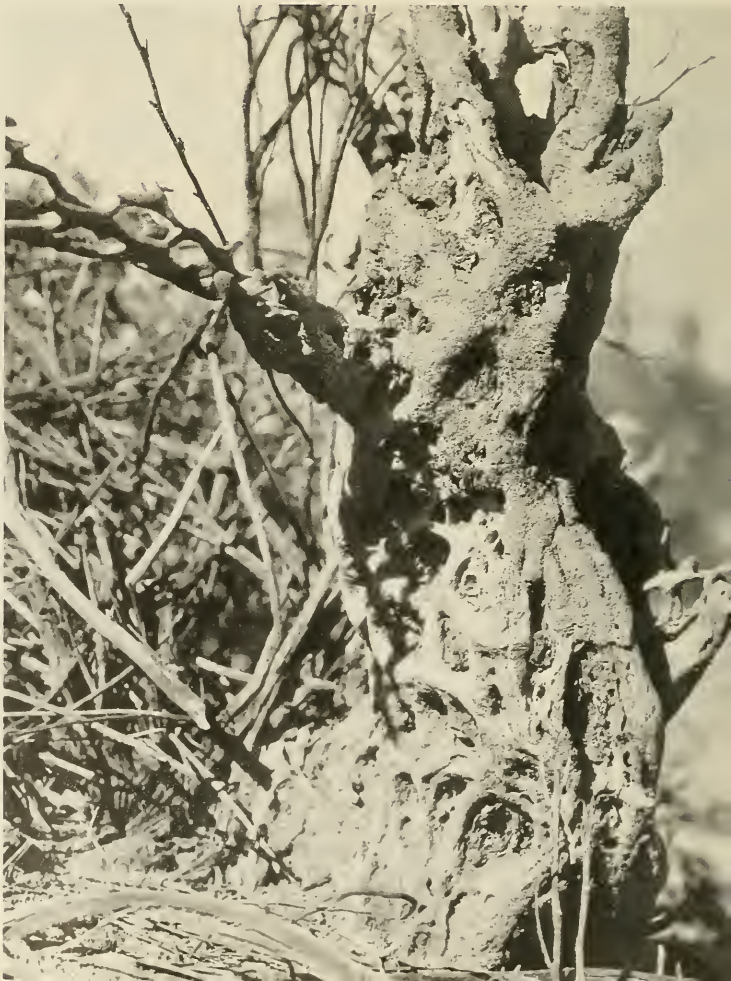
Photographs by the author and G. E. Kirkpatrick

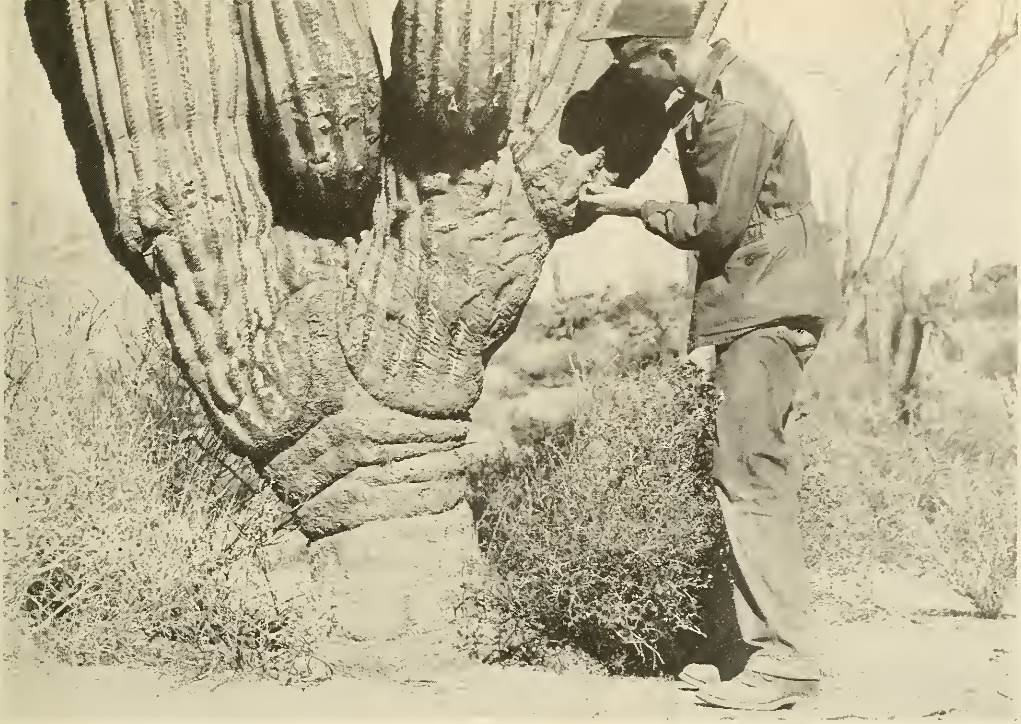
ONE of my first impressions of the desert was its extreme cleanliness. At the time, I was fresh from the East where rotting leaf mould and decaying stumps were an integral part of all vegetated regions. These new cactus areas, however, had a dearth of dead or dying branches. Why had the changing seasons not left a profusion of this refuse? Instead, the ground looked as though it had been swept with a brush, and even suitable kindling for a small fire was difficult to procure. True, some of the chollas had dropped their living slips, and from the shaded undersides tiny roots had penetrated the ground. But what had happened to those that had been slow to take root and had succumbed to the broiling rays of the sun?

A few had no doubt been purposefully removed by pack rats to fortify their dwelling entrances. Perhaps kit foxes, coyotes, and rabbits had "not so purposefully" removed others, when the sharp spines had penetrated skin and gained a free ride of dispersal to other regions. Strong winds and flash floods could have carried off many more, but even windbreaks and dry arroyas did not show accumulations of debris.

Several years later and 300 miles south in Lower California, I uncov-

▼ THE AUTHOR explores the work of termites on the edge of Chapella Dry Lake, in California

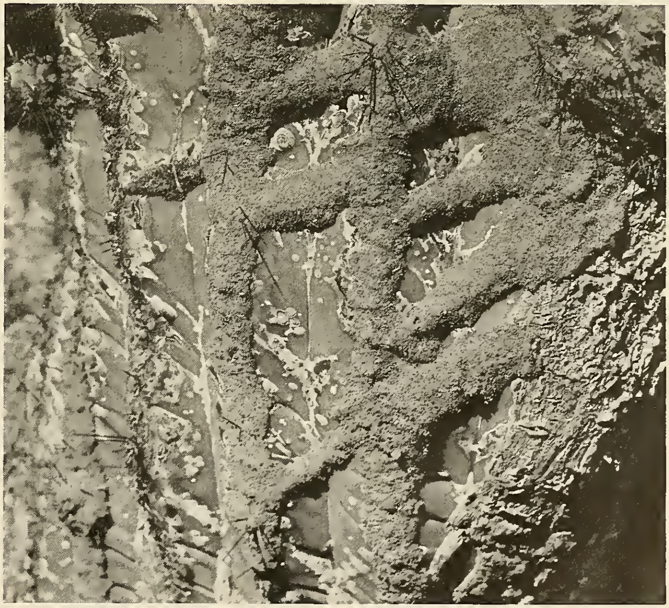




RMITES EATING a cholla skeleton. wood is covered with termite mud

▲ PHOTOGRAPHER G. E. KIRKPATRICK examines the termites' mud houses

▼ TERMITE MUD NESTS cover the flaked areas of a Mexican Cardon tree

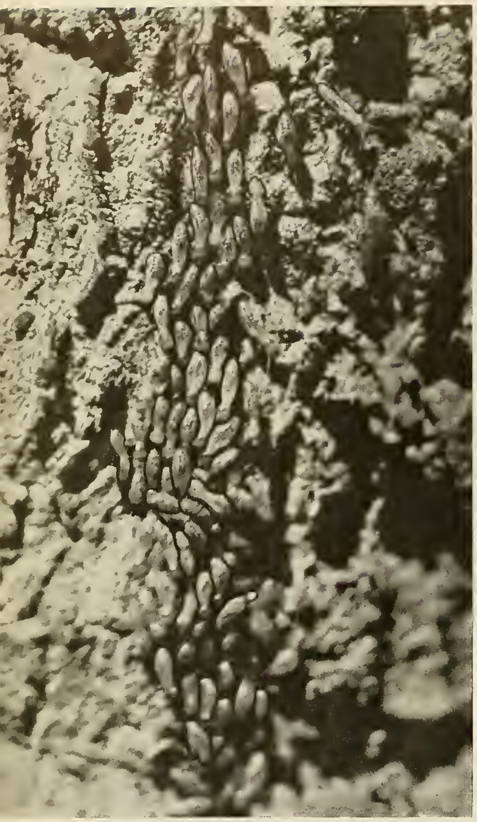


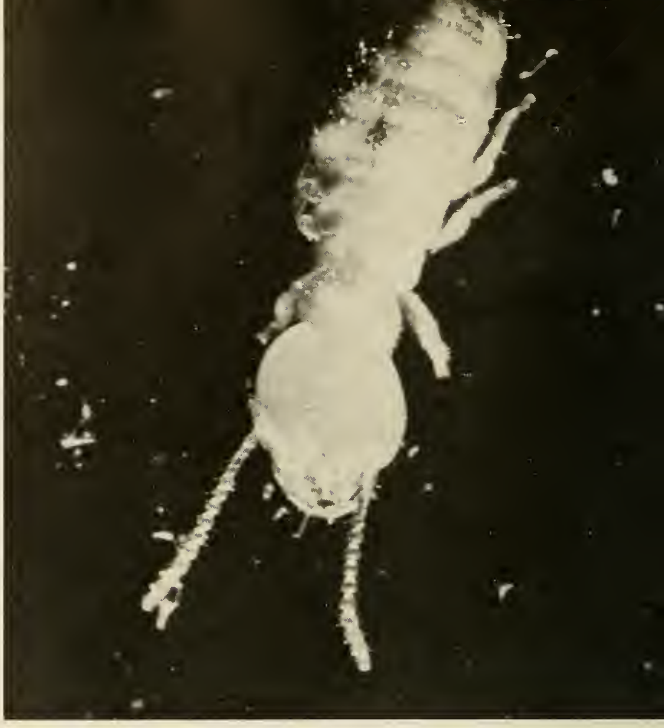
ered the first step in the solution of this mystery. My command car had just passed over the dry lake called Chapella and for the first time in three days of travel had been able to jump from ten miles an hour to a speedy sixty. A trail of dust left a two-mile floating wake. Indeed, when some cactus-strewn mountains were climbed, we found that a quantity of this dust had clogged our carburetor, practically preventing the flow of gas.

After the trouble had been remedied, we collected our tools from scattered positions and accidentally brushed one against a brown bough. When touched, the bough disintegrated into small flakes of mud. At ground level there remained a ring of soil about a half-inch in diameter that had walls less than a thirty-second of an inch in thickness.

With this clue to direct our search, we found that termite workings were abundant in the area. Some, like our first find, were just hollow reminders of a cactus that used to be; others were busy thoroughfares, with the light-shunning insects parading up and down in the channels under the mud.

These cactus-eating termites all seemed to be terrestrial. The aboreal varieties, which can exist without actual contact with the





◀ TERMITES ARE EXPOSED by flaking off the mud walls of their "apartment-houses." Here their dwellings are built on a cardon cactus

▲ A TERMITE WORKER greatly e larged. Termite society is a highl organized one, with groups of i sects having specific duties

▼ TERMITE WORK on ocotillo

ground, were missing. The upper ends of the working mud tubes housed the workers, the industrious members of the complex civilization, while at ground level the soldier or warrior members remained on guard. In the dirt below, there were no doubt yards of tunnels and galleries where one or more queens spent their lives laying eggs and where the larval young were raised to be future workers.

Their menu was varied; it seemed that few if any plants in the region were spurned. Even the dried scales that run up the spine ridges of the giant cardons (Mexican Saguaros) were devoured. Some of these large trunks were completely encased with a film of protective mud, while a few were crisscrossed with a beautiful pattern of surface tubes which followed the scale but missed most of the green living tissue.

In other climes there are termites that are dependent on only a single species of wood. So perhaps these that we saw in Lower California were really many varieties that had happened to settle in the area. The classification of termites, however, is a complex study, not always based on outward appearance of the insect but at times on the tiny living organisms that exist within the body cavity and digest and make palatable the wood pulp eaten by the host.

Several months later I again passed the spot near Chapella and found that the termite workings were a wonder of the past. The area once littered with debris was noticeably cleaner, but the knowledge of "what to look for" has made the discovery of these mud tunnels somewhat commonplace. Now a diligent search in any desert area usually reveals evidence of this Desert Division of Street Cleaning at work.

▲ A WEATHERED IRONWOOD tree with a termite mud shell

Natural History

CRYPTOMAZE

MAMMALS *By* EDWARD DEMBITZ

Part I. In this test you are given a set of definitions, each with a set of blank spaces, and a diagram to be filled in. Each definition is a clue to a word whose letters you are to insert in the blank spaces preceding the definition.

12 10 5 17 6 5 *Founder of the Marine Laboratory at Bimini*

16 13 4 13 19 7 *Pink rose, named after a city in Syria*

14 18 22 *Evergreen, once widely used for bows*

7 8 24 12 13 *Marsupial which inspired a toy named after Theodore Roosevelt*

3 24 5 23 6 25 *American Egyptologist, co-discoverer of Tutankhamen's tomb*

11 17 21 11 12 13 9 10 *Any of a group consisting of the hoofed mammals*

19 18 4 15 17 8 12 18 *Indian tribe led by Osceola during war with U. S. troops, 1835-42*

3 20 6 10 9 24 20 *Carnivore used in Asia and Africa for hunting deer and antelope*

22 14 13 23 23 18 13 25 2 *Ship used by Lincoln Ellsworth on Antarctic expeditions* (2 words)

24 3 24 16 1 24 *National Park, Mount Desert Island, Maine*

9 20 8 5 15 11 4 *Element capable of transmutation by plutonium into fissionable U-233*

2 15 12 23 16 8 22 17 *An ancient type of man unearthed in England by Charles Dawson*

Part II. When you have filled in all the letters above, transfer them to the proper numbers in the boxes in the diagram below.

When the diagram is completed you will have a word maze containing the names of at least TWENTY-THREE WILD MAMMALS. To find one of these mammals, begin with a letter and move from space to adjoining space in any direction, including diagonally, until the name is spelled out.

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

Copyright 1949
By Edward Dembitz

THREE PRIZES. *The three contestants submitting the largest number of mammals fitting this puzzle will each receive a copy of* Wild Animals of the World, *illustrated by Mary Baker and written by William Bridges. This is an attractive and informative book published recently by the Garden City Publishing Company.*

Webster's New International Dictionary—1948 *(unabridged) will determine the eligibility of mammals. Any name in bold-faced type in the main section (A-Z) will qualify. One error will disqualify a contestant.*

In case of ties, duplicate prizes will be awarded.

Entrees must be postmarked on or before January 20, 1949.

Winners and scores will be published in NATURAL HISTORY *Magazine for March, 1949.*

The contest is open to everyone except employees of the American Museum and the Garden City Publishing Company.

FIRE WALKERS OF THE SOUTH SEAS

Continued from page 15

done, the man signaled and was released from the cabinet, apparently none the worse for his experience.

The reason this came so close to being the perfect trick, Houdini said, was that there really *was* no trick. The spectator could have done exactly the same thing himself. The steak did not perspire and so it cooked; the man did, and during the short time he was in the cabinet, evaporation of moisture from his skin kept it from getting too hot. The human body's automatic adjustment to abnormal heat, coupled with precise timing on the part of the performer, made the feat possible.

A more recent experiment in heat and its effects on the human body sheds further light on the feat of Chief Terii-Pao and his stout-hearted fire walkers. It was conducted in December, 1947, at the request of the U. S. Army Air Forces Command, under the supervision of Dr. Craig Taylor, physiologist and engineer at the University of California, in Los Angeles.

The Air Corps wanted to know one very important thing: What were the dangers of a jet-plane pilot's being roasted alive in a friction-heated cockpit? These supersonic craft, powered by jet propulsion, need refrigeration systems to keep the cockpits comfortable and bearable. What would happen to the pilot if the cooling equipment failed? Would he collapse at the controls; would he succumb to heat prostration? Would he have to bail out in the stratosphere or else be literally baked alive in the cockpit? Could he stay at the controls, enduring the terrific heat, until he was able to slow down the plane?

Professor Taylor decided to find out. With the help of assistants, he made a heat chamber from a huge steel cylinder and provided a strong fan to suck in dry air across an outside battery of white-hot electric grids. The first human guinea pigs stayed in the hot-box until the heat passed the boiling point of water (212° F.). These volunteers came out a little groggy and florid-faced but quite "uncooked."

Then Professor Taylor made himself the subject of a most impressive test. His hands, feet, and neck were protected before he was wheeled into the cylinder, the temperature of which had been raised to 230°. He remained in this overheated atmosphere for 15½ minutes, until the heat climbed to 262°. The only effect upon him was that his face became fiery red when the hot blasts of air hit it. Apart from this, he suffered no adverse physical or mental torture.

His answer was simple and to the point: nature has provided the human body with its own cooling system—perspiration. He proved that moisture evaporating from the skin provides parts of the body with a layer of cooler air. A desert water bag hanging from the rear of a car keeps cool from its own evaporation of moisture through the porous canvas.

Inside the hot-box, Professor Taylor learned that when the temperature was 236°, the air three-fourths of an inch from his nose was 226°. The skin of the nose itself registered a safe 119.5°. Air drawn into the nostrils was cooled down so much that it did not affect the lungs. The general temperature of the body rose only a couple of degrees.

Professor Taylor emphasized that there was danger if the raised temperature was conveyed to the brain cells. This would give pilots of jet planes the surest indication of approaching heat prostration.

He gave this advice. People should realize that the danger from heat is partly emotional. Human beings, whether pilots or persons trapped in burning buildings, can overcome high registers of heat by rational, well organized attitudes of self-preservation. Fright or over-excitement can contribute to an increase in the temperature of the blood.

The fire walkers of Raiatea have had no indoctrination as to the scientific principles of heat. Therefore, they quite understandably look to a supernatural explanation of their safe transit of the fiery *Umu*.

Still, the fire walk is not a bad performance. I think Professor Taylor would find it quite interesting. And Harry Houdini would have to admit, were he alive today, that Chief Terii-Pao, at heart, is not entirely a fraud.

BOOKS

Continued from page 7

guage, and very simple to use. Thirty of the fifty-two species listed are illustrated by excellent photographs. It is unfortunate that Dr. Smith has chosen to treat as distinct species forms which are probably not even valid subspecies. Thus, he names no less than six species of *Poritis* instead of the two now generally recognized.

The introductory chapters contain an interesting discussion of the distribution and formation of the coral reefs of the world, as well as a more detailed treatment of the western Atlantic reefs. Bearing in mind that Dr. Sheppard's important monograph, *Submarine Geology*, was in press at the same time as the *Atlantic Reef Corals*, these chapters can be said to present a fair review of the various conflicting theories of coral reef formation. It is somewhat surprising, however, to find that on page 39 credit is given to the Miami Marine Laboratory for discovering reef corals off the west coast of Florida; these have been known for a long time and were shown on Joubin's maps (1912) of the coral reefs of the world.

The remaining chapters discuss the structure, habits, collection, and preparation of corals and give a brief account of the more common animals associated with the corals. An appendix presents a glossary of the principal technical terms used by coral specialists and contains a highly technical key to all the known genera of western Atlantic corals, including the non-reef building and deep-sea corals as well as the true reef corals.

The chapters on structure, while clearly written, could have been much improved by the inclusion of additional simple diagrams. Perhaps the author intended to do so, as on page 45 there is a reference to a "figure 12" which is not to be found, at least, in my copy.

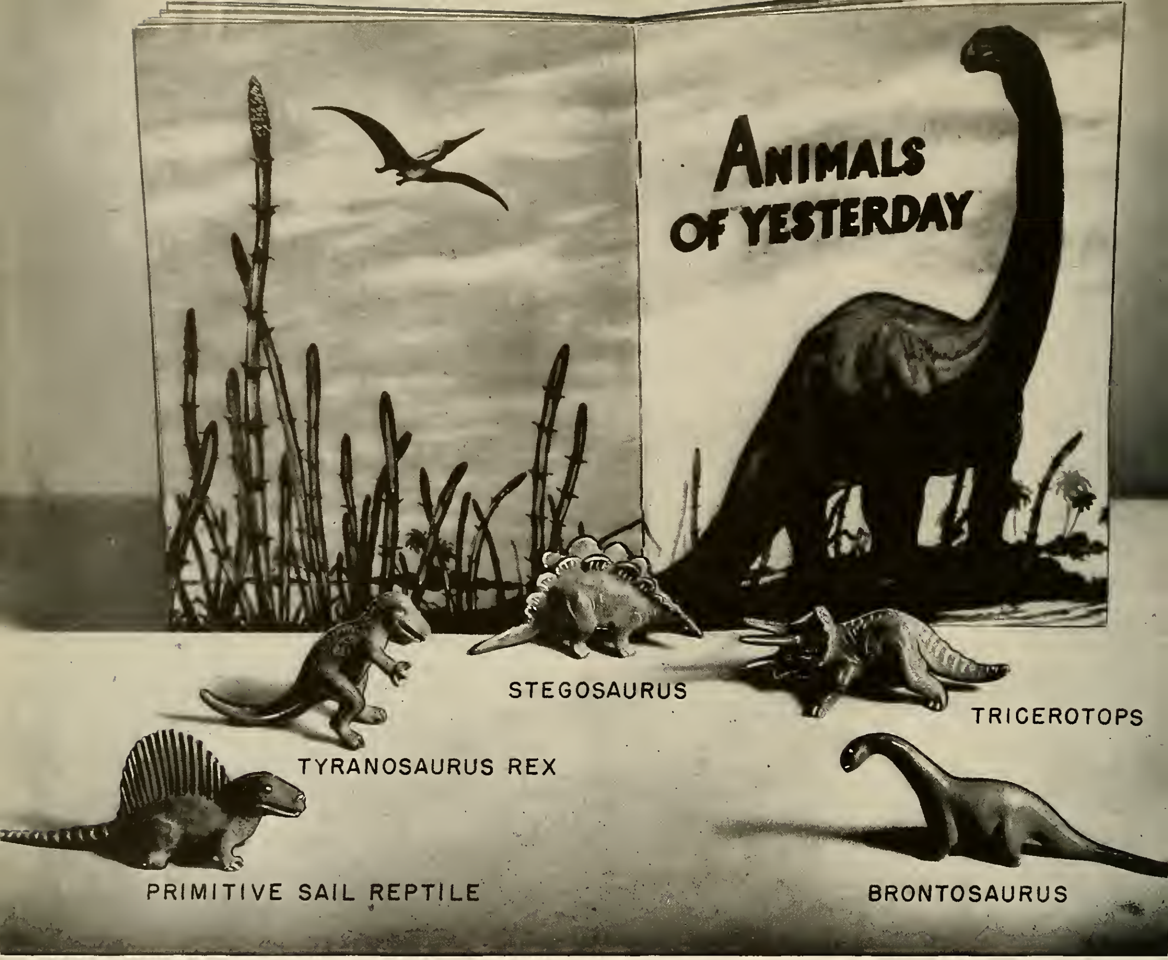
There appear to be few other misprints, although on page 104 the term "ventriculate" applied to the peritheca of *Acropora* should be "reticulate," and on page 106 the brackets which should enclose the name *Madrepora* have been omitted.

John C. Armstrong.

February NATURAL HISTORY 1949

Bushman Brushwork · Giant African Snail · Horned Toad

Your Aquarium · Ospreys at Home · How Eels Reproduce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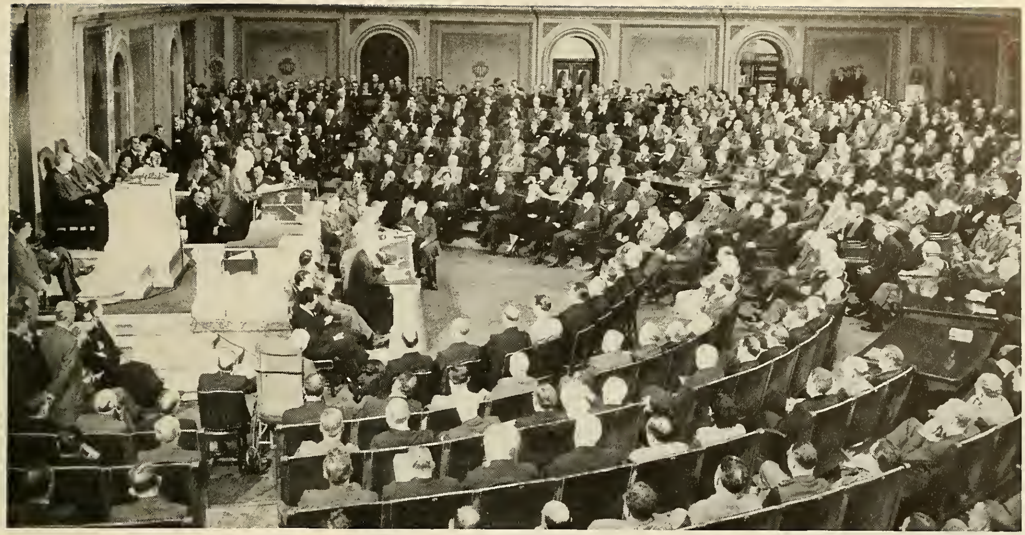


Acme

Attention Conservationists!

A NEW Congress is in session. Important conservation problems are coming before it. If it is to act wisely, its members will need the advice and active support of every one of their conservation-minded constituents. Many of the members of the Eighty-first Congress are new to these problems, and all are subject to pressure from those who would overexploit publicly-owned resources or invade our precious National Parks and Federal Refuges.

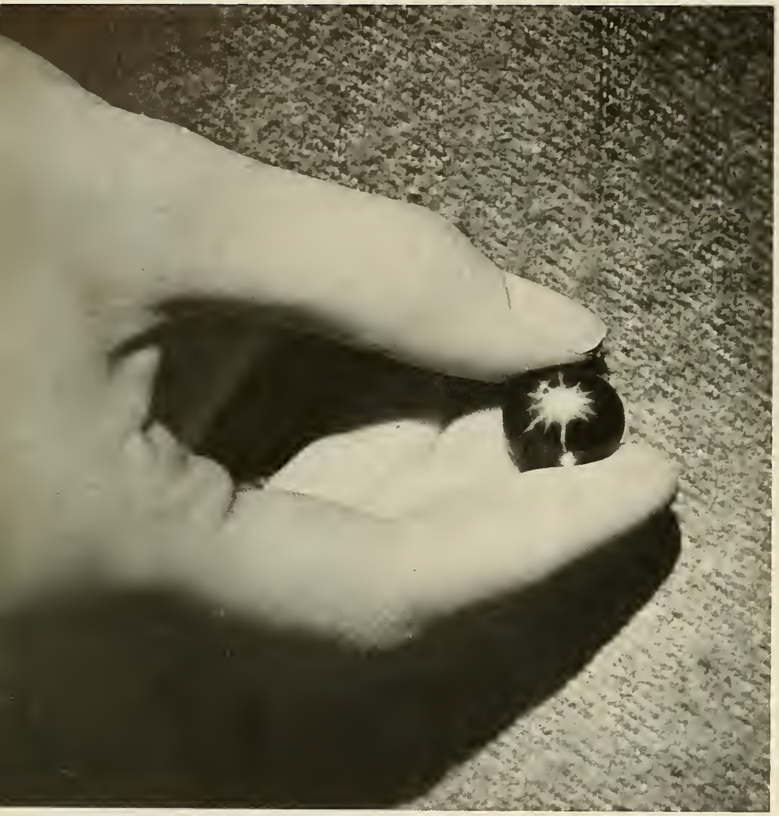
The demand for funds for the many thousands of activities in which the Federal Government is involved always exceeds what Congress has at its disposal to appropriate. Few government bureaus get all that they think they need to properly carry on the work assigned to them. Some, however, get considerably more than others, and if conservation agencies like the National Park Service, the Fish and Wildlife Service, the Forest Service, and the Soil Conservation Service are to be at all adequately financed, interested citizens like yourself who know the value of their work will have to let their Congressmen know how they feel. Congress will receive thousands of letters in favor of benefit payments and local pork-barrel schemes. If conservation is to get its due, every conservationist —and there are all too few of us— will have to write not one but many letters during the course of the Eighty-first Congress.

Too many conservationists have a tendency to believe that conservation problems can be solved simply by passing legislation that places the problem or the land involved in the hands of some government agency. All this actually does is to make each and every one of us responsible for it year after year. Nothing is accomplished by requiring surveys by the Fish and Wildlife Service of the possible damage to wildlife values that may result from the construction of certain dams if their funds are so inadequate that it will take them ten years just to study the projects already on the drawing boards. Nor is there any use in placing more land under the jurisdiction of the National Park Service if the Service is not going to be provided with an adequate budget for its maintenance. The Park Service's present budget is so inadequate that, swamped with land to administer and visitors to supervise, it is often unable to prevent vandalism and other activities that tend to destroy the very values for which the areas were given national park status.

Your interest in conservation makes you a member of a select, farsighted group of public-spirited citizens. So long as it is as small a group as it is at present, each member bears a great responsibility, for our conservation problems possess an urgency that will not permit long delays in their solution except at a disastrous cost to the nation. If they are to be solved, you and every other conservationist must make it your business to keep posted and to let your representatives in Congress know at frequent intervals how you think they should act on the various issues that are before them. Don't for a minute underestimate the value of your letters and those you can get your friends to write. One letter, even if it is in lead-pencil on an old paper bag, is worth a thousand complaints about what Congress did or didn't do after it has adjourned.

RICHARD H. POUGH,
Curator of Conservation,
American Museum of Natural History.

MUSEUM NOTES



Remarkable 12-Rayed Star Ruby

This unique star ruby was exhibited on loan in the American Museum's Morgan Hall for two weeks in January. It weighs 25.2 carats and is without a flaw. The gem, a deep violet-red in color, is remarkable for the double star that it shows. This star can be explained as the result of the intergrowth of two crystals in the same space, a phenomenon known in mineralogy as "penetration twinning." The two networks are oriented at 30 degrees to each other, so the inclusions that form the star produce, in this stone, two sets of arms, or twelve in place of the usual six.

The stone was recently found in Ceylon and is the first of its kind ever discovered in 3000 years of mining in the rich Ratnapur mines. In its rough state, the stone passed through several hands before it was polished and the remarkable star disclosed. After display in the Museum, it was returned to Ceylon, and it may be shown later in Europe.

"Around the World with Dance and Song"

For the past seven years a unique and fascinating program of ethnic dances, called "Around the World with Dance and Song," has been drawing capacity audiences to the huge auditorium of the American Museum of Natural History. Leading artists and dance groups in picturesque and authentic costumes have transported thousands of delighted dance lovers to faraway lands through colorful dances and music, ranging from the exotic rhythms of the East to the vigorous and exciting arts of the Western World.

Because of the enthusiastic public response to these programs of international cultures, the Museum has arranged its first season of subscription performances of "Around the World with Dance and Song." This new series will include an afternoon program especially adapted to children at 2 P.M. and an evening program for adults, given by the same artists, at 8:30 P.M. The performances will occur on seven Thursdays from February 10 through May 5, 1949.

Among the featured artists and groups will be the Korean Dance Troupe on February 10 and Dvora Lapson and Company on February 24. The Korean Dance Troupe, the only group of its kind ever to come to America, will present a program titled "Korean Springtime in Dance and Song." The dances of Korea are deeply rooted in Korean culture and are totally unlike anything else in the Orient. Unique, colorful, and engaging, they are as varied and charming as the music and costumes. The program will include one of the ancient farmer's dances, the delightful Doll Dance, a humorous Masked Dance, an enchanting Swing Dance, and a dramatic Korean Drum Dance. Mr. Taik Won Cho, leader of the group, is of royal birth and is one of the leading dancers and choreographers of Korea. He has dedicated his life to bringing a closer understanding between his people and the people of America. He stated recently, "The tides move swiftly. Perhaps you can understand us quickest through our dances and our music."

"Treasury of Hebraic Dance," presented by Dvora Lapson and Company on February 24, will include the beautiful "Queen Sabbath," the "Jewish Wedding Suite," dances based on Jewish folklore, and dances of Israel. Internationally recognized as a pioneer of Jewish dance, Dvora Lapson has created an extensive repertoire of Hebraic dances and mimed episodes, portraying the life and traditions of the Jewish people.

Other programs in the varied series will feature Reginald and Gladys Laubin in "Arts and Dances of the First Americans" on March 10 and the Radischev Russian Folk Dance Group and Polyanka Ensemble in "Festival of Russian Folk Art" on March 24. Lyda Alma and Yianni Fleury will interpret "Greece in Dance" on April 7, and on April 21 "Traditional Haitian Rhythms" will be performed by Josephine Premice and Jean Leon Destine and Group. In the final recital of the series, La Meri, assisted by her Company, with Juana, will present the exotic dances of various countries of the Old and New World that she has visited.

Further information and tickets can be procured from Hazel Lockwood Muller, Department of Education, American Museum of Natural History.

Expedition Returns from Australia

The first major American expedition to the remote Cape York Peninsula in Australia returned to the American Museum of Natural History in December after

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NATURAL HISTORY

The Magazine of the American Museum of Natural History

F. Trubee Davison, President
Wayne M. Faunce, Vice-Director
In charge of Publications
Albert E. Parr, Director

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FEBRUARY, 1949

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You will find Natural History Magazine indexed in *Readers' Guide to Periodical Literature* in your library

THE COVER THIS MONTH

The quaint Guatemalan village of San Antonio Aguas Calientes, situated at the feet of the volcanos named Fuego ("Fire") and Agua ("Water"), is well known for its *huipiles* (blouses) and *tzutes* (kerchiefs or serviettas), like those worn by this native girl. Specific designs pertain to the town, and a girl of thirteen must know these and be a capable weaver before she is qualified for marriage.

The spare time of many months is required for weaving such a huipil on a narrow stick or belt hand loom. The brocade patterns of brilliant colors are generally "floated," appearing on the outside only. On the reverse side, which is plain dark blue, an occasional band of the design is carried through as evidence of the rich workmanship on the outside. For ordinary use the huipil is worn reverse side out, and the right side is equivalent to a party dress.

The tzute is an all-purpose cloth serving as protection against the sun, a cover for baskets carried on the head, or as a carry-all. It is a distinctive type of brocading in Soumak and weaving similar to double-running technique in embroidery. It generally is 30 by 40 inches, with all edges selvaged. Designs of birds, animals, and flowers over the geometric motifs lend charm to the soft, finely woven pieces. Margaret Robertson Smith.

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seven months in the field. The 1948 Archbold Cape York Expedition, as it is officially known, brought back extensive and significant collections of mammals, plants, reptiles, and insects. Spiny Anteaters, Spotted Cuscuses, tiny Musk Kangaroos, "Flying Mice" (smallest of the flying phalangers), and the rare Bennett's Tree Climbing Kangaroo are included among the 1500 mammal specimens, which represent more than 50 species. Dr. G. H. H. Tate, Curator in the Museum's Department of Mammals, states that the extensive collections secured, together with existing specimens from Australia, will give the American Museum one of the greatest Australian mammal collections in America.

Interest is shown by layman and scientist alike in the Tree Climbing Kangaroo, two species of which occur in Australia and several in New Guinea. These kangaroos rarely descend to the ground and even probably bring forth their young in the treetops. They feed on a diet of leaves and fruit. Unlike true kangaroos, they do not employ the tail as a jumping aid but rather as a balancer in tree climbing.

The Spiny Anteater is a survivor of an Order of mammals of probably wider distribution in the Mesozoic Era, 60 to 70 million years ago. Like the more widely publicized Platypus, it is an egg layer, but it is equipped with two-colored spines which serve effectively as armor. It is also provided with digging claws on both front and back legs, and its long narrow snout further helps it to burrow.

The expedition brought back the first representative collection of plants from far northern Australia ever to reach this country, according to Leonard J. Brass, expedition leader and botanist. It almost certainly includes a number of entirely new species. The botanical collection becomes the property of the Arnold Arboretum of Harvard University, which helped to finance the expedition. After study and classification by Australian botanists at the Queensland Herbarium, duplicate specimens will be distributed to other institutions in the United States and abroad. A tree that is reported capable of killing a horse—the so-called Stinging Tree—is among the plant forms to receive considerable attention in the press as a result of the expedition. Though one species of the tree is only about 10 or 12 feet high, the Museum scientists readily testified to the extreme pain it is capable of inflicting.

A collection of more than 500 reptiles and amphibians was brought together by Geoffrey M. Tate, who also served as Business Manager of the expedition. These include two specimens of Johnston's fresh-water crocodile, which is new to the Museum's collections, and the Death Adder, a snake that is extremely poisonous though it seldom reaches more than two feet in length. This snake, however, is not as much feared by the natives as is the seven-foot Taipan, a rare and extremely deadly snake found on Cape York. Among other reptiles are a twelve-foot Carpet Snake, named for its close resemblance to the markings of Oriental rugs, and some five-foot specimens of the big Monitor Lizard, which Australians call Goannas.

In addition, thousands of insects and spiders were brought back.

The expedition, which traveled from end to end of the Cape York Peninsula, a distance of 500 miles in a straight line, is part of a continuing program of field work carried on in the Indo-Australian area by the organization known as Archbold Expeditions. Three previous expeditions had explored New Guinea in furtherance of the program before the war. The Cape York Peninsula and New Guinea provoke special scientific interest because of the probable existence of a former land connection between them. This land bridge formed a two-way traffic route for plants and animals. Most of New Guinea's marsupials (pouched mammals) are of Australian origin. The wallabies, bandicoots, and many birds of southern New Guinea would be familiar to Australians. Most rodents and a great many plants of eastern Australia came down through New Guinea.

In addition to those already mentioned, the expedition included Hobart M. Van Deusen, who assisted in the search for mammals, Mr. Donald Vernon, chief preparator of the Queensland Museum, Mr. Joe McLaughlin, a long-time resident of the Cape York area, and three aboriginals from the Cowal Creek Government Mission, who assisted in the hunting and trapping, as well as in the collecting of plants.

Many Thanks

SIRS:

Many thanks for your interest in my letter regarding extra copies of NATURAL HISTORY for the sanatorium at Colchester [published in NATURAL HISTORY last December] . . . Frankly, my husband thought I was crazy to write, but now I am very glad I did, knowing how much the Magazine will be enjoyed if anyone is good enough to offer a subscription. I still will be glad to help with the postage, if necessary. . . .

MRS. W. BRITTAIN.

London, England

NATURAL HISTORY is happy to announce that two members of the American Museum have signified their willingness to sponsor a year's subscription to the Magazine in response to Mrs. Brittain's inquiry regarding "extra copies."—ED.

YOUR NEW BOOKS

CHINA • GEORGE CATLIN • BADGER
JUNGLE MAN • MACHU PICCHU • CONGO

CHINA: THE LAND AND THE PEOPLE

- - - - - by Gerald F. Winfield

William Sloane Associates, $5.00
437 pp., 2 maps, 29 photos

THE romantic veil is again lifted from China. What is revealed beneath is enough to make one forget momentarily about silks and teas, about porcelains, jades, and bronzes, perhaps even about opium and bird's-nest soup. Instead of Mandarins dwelling in idyllic "willow-pattern" surroundings, we are made to see the highly honored but toilsome life of the small farmers.

These country folk, numbering fully 80 per cent of a supposed half billion population, together with a sprinkling of officials, scholars, artisans, and laborers living mostly in walled cities, occupy a solid block of territory larger than the Greater United States. China proper, or the Eighteen Provinces, lies exactly within the limits of our own continental latitudes; but, having been partially isolated by natural boundaries, her largely homogeneous peoples and their common culture have necessarily developed along independent lines until today, after nearly 5000 years of either traditional or recorded history, her civilization presents many peculiarly distinct traits. In fact, so set in their own social ways and so delicately adjusted to their natural environment are the Chinese that our sympathetic author believes radical measures are required to help them out of their present relatively static condition.

Specifically, the first half of this timely book describes in considerable detail Chinese agriculture, diet, clothing, and housing as well as health conditions, education, language, and local government. The reader will find here not only many astonishing facts relating to the various deeply integrated aspects characterizing the daily life of a hitherto resourceful and sophisticated nation but also much food for thought. The second half deals constructively with the imperative "rebuilding of China," through general education, sanitation, land reform with accompanying improvement and expansion of agriculture, and the further development of nascent manufacturing industries. The last step is regarded as the only normal way in which to reduce a too dense farm population to the point where higher standards of living become possible all around. In brief, while China long since achieved, by the so-called old trial-and-error procedures, a cultural status that was doubtless satisfactory for a time, it is now necessary for her to introduce modern scientific methods.

The obvious political implications of these economic and social reforms have no place here. It must suffice merely to indicate the author's opinion that China's future welfare constitutes a "direct challenge to the West," a challenge to be neglected only at our own peril.

NELS C. NELSON.

JUNGLE MAN

The Autobiography of Major P. J. Pretorius. With a Foreword by Field-Marshal J. C. Smuts

- - - - - by Major P. J. Pretorius

E. P. Dutton and Company, Inc., $3.75
256 pp., 15 illusts., 2 maps

ALL too often the ivory hunter was no brave pioneer but a poacher, contemptuous of government. If, in wartime, he became a useful scout, he was redeemed. Such a life story is here related in the first person; and since Field-Marshal Smuts vouches for the scouting, that merit must be accepted.

In some other periods of his career, however, Pretorius seems far less heroic. As a young man in Zambesia, he hunted, traded, and quarreled with natives. Later he sought ivory in German Ruanda and again became involved in battles with the inhabitants. Small wonder that he was arrested and sent to the coast for trial.

The Prussian heel may have been heavy in East Africa; but after a short prison sentence Pretorius was again permitted to hunt elephants. With profits of $17,000 in six months, he started a cotton farm on the Rufiji River; but when a new elephant license was refused him, he went over into Mozambique for ivory. Soon the Germans confiscated the farm, and I cannot share his indignation.

Seeking vengeance, Pretorius made successive raids back into German East Africa until he had tusks equaling the farm in value. Then came World War I; shot in both legs, he succeeded nevertheless in reaching Nyasaland. Unfit for military service, he soon was drafted by the Admiralty to locate the cruiser "Königsberg" in the Rufiji Delta. What a chance for revenge; how sweet its realization! Thus began his notable services as a scout.

In 1920, the passion for slaying elephants revived itself. Pretorius was engaged by the Government to reduce the Addo Bush herds. During that ruthless campaign one of my closest friends visited him in his elephant camp. The Major was certainly tough, in every sense of the word! If that be an inspiration, then Heaven help the big game of Africa.

JAMES P. CHAPIN.

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THE NEW NATURALIST—
A Journal of British Natural History

- - - - - Edited by James Fisher

Collins, 14 St. James's Place, London, 21 s.
216 pp., 12 color and 175 black-and-white photos

NOTHING could be easier than to introduce the first edition of a new natural history series, especially when it is edited under the leadership of such a competent naturalist as James Fisher.

The New Naturalist is a journal of British natural history, published annually, though future numbers will be issued quarterly as soon as it is possible to do so. This edition is not just a first number of a periodical but a special issue complete within itself; and, judging from its merits, succeeding numbers should be of immeasurable value to every nature lover.

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with a view to making the journal popular by substituting fancies for facts. Natural history is a tradition in Britain and is, in fact, a very old one at that. It has been cultivated far longer and with greater zeal than in any other country in the world. There are hundreds of local natural history societies in Britain, with a total membership of over a hundred thousand. The British are not hasty in their selection of literature, but they are sticklers for accuracy. In some of my reviews I have purposely omitted criticism of inaccuracies, especially in illustrations, that might seem appalling to a trained naturalist, but there are no such cardinal errors in this journal.

This first volume is divided into four parts, denoting the four seasons of the year, each section of which embraces a special subject compiled by several competent authors. Thus the Spring Number is entitled "Woodlands," and the Summer one, "The Western Isles of Scotland." The Autumn Number is on Migration, and the Winter one is entitled "The Local Naturalist." The book is lavishly illustrated in color and black and white, and the superb photographs should win top prizes in any photographic contest. The articles were carefully chosen for their quality, scope, and variety.

George G. Goodwin.

Pursuit of the horizon

A Life of George Catlin

- - - - - - - - by Lloyd Haberly

The Macmillan Co., $5.00
239 pp., 17 illusts.

An account of the life of George Catlin is timely and valuable since few today are acquainted with the history of this extraordinary man of genius to whom we are deeply indebted. We know a great deal more about our frontier life—Indians and bison—than we would had Catlin not lived.

In reading about this man of vision, of his enormous energy and enthusiasm, of his constructive and discerning mind for man's betterment, I am reminded of Carl Akeley. Unusual minds like these generally encounter difficulty in bringing the great body of the usuals to cooperate with them. As the story of Catlin unfolds, it becomes more and more engrossing. I myself long ago, when advised to remain in Europe where I had studied instead of returning to America, saw the vast and marvelous pictorial opportunities here. Despite the warnings of difficulties with which I would have to cope, my vision brought me back.

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"It is dime novel stuff" . . . "It is inartistic" . . . "There is nothing in America to paint." These expressions of blindness and stupidity no doubt were hurled at Catlin, as at me, but they glided off.

Mr. Haberly has shown a deep understanding and insight in his picture of Catlin—a very difficult picture to draw. I cannot escape the conviction that had Catlin concentrated and confined his efforts to our Plains Indians and not merely sketched but composed portrayals of their lives in more intimate and convincing detail, his work would have shamed and silenced the carping Schoolcrafts and their ilk.

It is a thousand pities that this trail blazer, this man who sacrificed everything for an idea—a big and sound idea—did not receive more co-operation from a public for whose benefit he was working. This is the biggest lesson Mr. Haberly teaches. William R. Leigh.

THE NEW CONGO

- - - - - - - - - by Tom Marvel

Duell, Sloan and Pearce, $5.00
395 pp., 10 maps

TOO many Americans think of the Congo as a land of jungles, fevers, and dangerous beasts. Tom Marvel, after working there for the O. W. I., decided the world should hear rather of the amazing progress made within the span of a single life, since the country was opened by Stanley.

As background he gives a short account of its exploration and pacification, the collaboration of Henry M. Stanley with Leopold II, the founding of the Congo Free State. The abuses charged against the Free State were slight compared with the earlier cruelties of Arab slavers.

After a graphic picture of the geography and the great river system, we are taken on a tour of the great Belgian Congo and Ruanda-Urundi, just as Marvel saw them after World War II. The Congo produces not only copper and tin but gold, tantalum, cobalt, and a large share of the world's industrial diamonds. If you fail to find uranium in the index, just look up radium. Palm oil and cotton form but part of the Congo's vegetable wealth.

It has been claimed that government in the Congo is too paternalistic; that all which is done for natives is designed to increase dividends. But no one can deny the benefits in health, security, and economic progress. The system enabled the Congo to contribute enormously toward victory over totalitarianism.

Some of the newer activities here described are the National Institute of Agronomy, silkworm culture, elephant domestication, and the four National Parks. All through the book, emphasis is placed on the training given to natives for the varied careers now open to them. If "every prospect pleases," it must be remembered that Tom Marvel set out to show us the bright side, and for this the new Belgian Congo offers vast possibilities. James P. Chapin.

THE BADGER

- - - - - - - - - by Ernest Neal

Published by Collins, 14 St. James's Place,
London, 12s.6d. net
158 pp., 30 photos, 12 maps

DESPITE the ever-spreading towns and villages that yearly encroach on the countryside of rural England, there is still a wealth of wildlife to be found that has survived throughout the intervening years from historical times of Robin Hood to the present day. This first book in the monograph series of the "New Naturalist" will stimulate the interest of the general reader in wildlife by recapturing, at least in part, some of the inquiring spirit of the old naturalists. In a study of British fauna there is perhaps no phase more difficult to cover than the life history of the badger. It is strictly a nocturnal creature and the shyest mammal found in Britain.

Ernest Neal not only watched the artful maneuvers of these cautious creatures during the dim light of night, but he took some excellent photographs of them in their native habitat—in pairs, singly, and in groups of four or five adults. In one picture, he even caught both of the parents and two young.

The text itself is a noteworthy contribution to the life history of the badger. Mr. Neal has, with indefatigable patience, solved many of the mysteries surrounding the life cycle of this night prowler, and he has also pointed out many problems still to be worked out.

The Badger, like all the "New Naturalist" publications, bears the stamp of scientific accuracy, and in good measure represents the author's many hours of personal observation. The final results of his research, as published in this volume, give a picture of the life cycle of the badger and its habits throughout the seasons, including its behavior in times of play, defense, and attack.

George G. Goodwin.

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LOST CITY OF THE INCAS

- - - - - - - by Hiram Bingham

Duell, Sloan and Pearce, $5.00
263 pp., 60 illusts.

THOSE who have been privileged to visit Machu Picchu will never forget it. Those who have not, and hope someday to travel in South America, should include it in their itinerary. This remarkable citadel, constructed by the Incas on an inaccessible mountain crag in the eastern watershed of the Andes, is truly amazing.

Today, as one travels there on the railway from Cuzco, it is hard to realize how inaccessible it was even as recently as 1911 when Hiram Bingham found it. The account of this discovery, well told in the present volume, is a welcome addition to the various scientific reports stemming from Mr. Bingham's six Peruvian expeditions.

Students of Peruvian prehistory will disagree with the author's suggestion that the structures at Machu Picchu antedated by centuries the development of the Inca Empire. His contention is based in part on legends and in part on structural differences in the masonry walls. The objections arise from the fact that all of the pottery recovered, both by Mr. Bingham and by later work, is what might be called Classic Inca. The identical ware occurs in middens on the Peruvian coast and is there datable as from the last half of the fifteenth and the beginning of the sixteenth centuries. As pottery styles and decorations change rather rapidly, it is hardly possible that Machu Picchu is as old as the author implies. This professional difference of opinion, however, in no way detracts from his story.

Junius B. Bird.

HENRY A. WARD

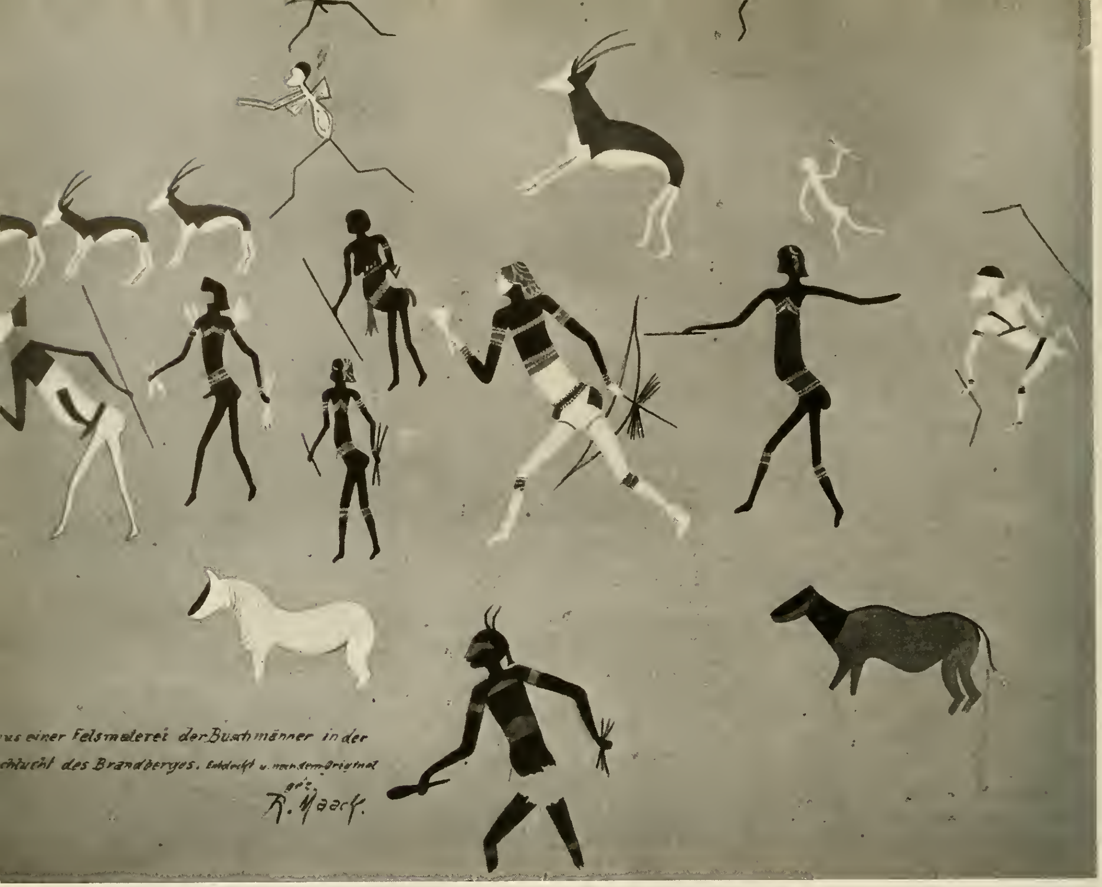
Museum Builder of America

- - - - - - - - by Roswell Ward

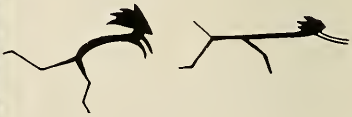
The Rochester Historical Society
Rochester, N. Y.
297 pp., 12 illusts.

THIS biography should prove of keen interest not only to those who have been associated with the American Museum long enough to share in its history but also to the many present-day collectors who have availed themselves of Ward's Natural Science Establishment. From its pages Henry Ward emerges as a uniquely great American of the latter nineteenth century, whose multifarious activities were a byword even in that era of varied careers and miraculous opportunities. His restless energy found its

Continued on page 96


us einer Felsmalerei der Buschmänner in der
chlucht des Brandberges. Entdeckt u. nach dem Original
gez.
R. Maack.

▲ A COPY OF A BUSHMAN PAINTING in which the central figure is thought to represent a white woman of Mediterranean origin. As described by the Abbé Breuil, her costume is a sweater, and the big cuplike flower she raises to her face recalls the ancient statuettes and frescoes of Knossos, in Crete. The Leopard's Ravine in which the painting is located is in the Namib Desert in extreme southwestern Africa



◀ STUDENT HELPERS in the vicinity of the Paul Loewenstein Cave near Ladybrand, Orange Free State. This cave is the scene of Professor van Riet Lowe's archaeological excavations

ANCIENT Bushman Brushwork

The world's largest "picture puzzle" challenges experts on the story of prehistoric man in South Africa

By BETTY AND VICTOR JORGENSEN

Photographs by Victor Jorgensen from Three Lions

SOME of the strangest, most fascinating, and yet unstudied pages in the history of man are penciled on the soft sandstone walls of thousands of caves and half-caves throughout the southern part of Africa. These sometimes faint, sometimes brilliant, but always delicate frescoes are the so-called art of the Bushman.

For years archaeologists have probed and sifted the sands of Egypt, have scraped and mapped the olive-crowned hills of Greece, and have studied and debated the prehistoric paintings in the caves of Andalusia, the Pyrenees, and France. But except for a small group of enthusiasts (so small that in almost 50 years they have done little more than scratch the surface of this tremendous record), there have been few extended studies of Bushman art.

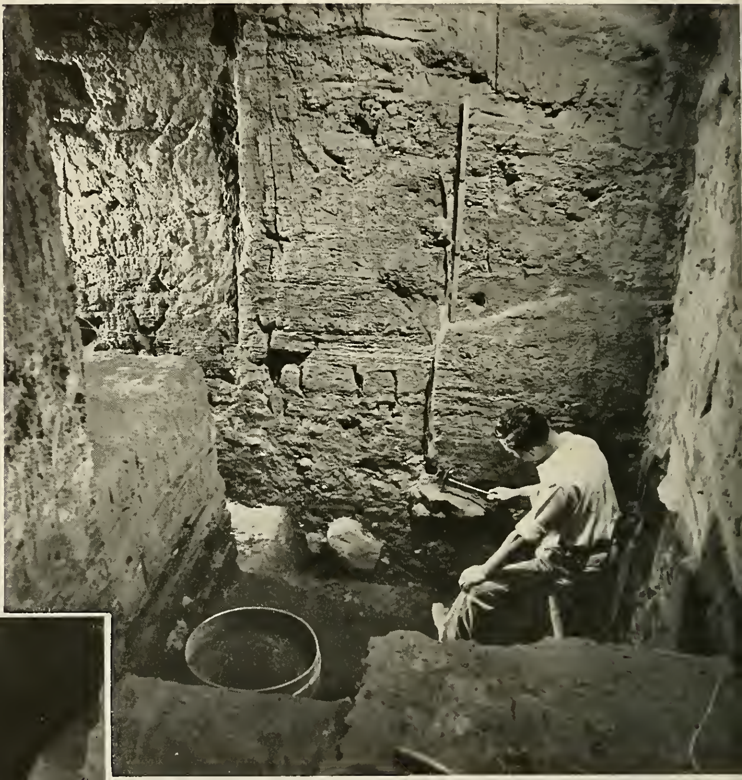
Even the term "Bushman art" is unstudied. Although there is little doubt that a large percentage of the rock paintings still visible were executed by the Little People, as the Bushmen are known, there are

▼ TYPICAL CAVE PAINTING COUNTRY: a scene at the end of the road in Orange Free State. From here it was five miles through upland meadows to Ho Khotso on the Caledon River

other rock paintings that may be the work of some great unknown race who inhabited the cool, sun-swept highlands of southern Africa long before the Bushman arrived.

Yet the Bushman and his art are an unquestionably valuable avenue of research into prehistory, for as recently as 100 years ago, the Bushman was still living in much the same state as man of the Paleolithic age and was still painting in much the same way. His clothes were animal skins, his tools were bits of flaked stone, his paints were out of the ground, and his brushes were from the feathers of birds. There are a few Bushmen still surviving in the scorching wastes of the Kalahari Desert, but they are the scattered, broken remnants of a once-numerous race that held sovereignty over the entire southern end of Africa from the Zambesi to the Cape of Good Hope. So far as is known, none of the surviving Little People paint.

The geographical range of the ancient rock paintings is staggering. These paintings, and the even earlier rock engravings, are found throughout southern Africa from the Rhodesias south—not in single, widely scattered areas as they are in Europe but in an almost continuous belt that encloses literally thousands of caves and rock shelters, each with many examples of the primitive art. One of the most valuable studies of the art so far has been simply the listing of the various sites where paintings are found, a project originally started by Professor I. Schapera and A. J. H. Goodwin, of the University of Capetown, in 1925. The first compilation eventually was published in 1936, and the latest edition (1941) includes a listing of 1766 farms on which caves have been located. But this figure is misleading, according to Professor C. van Riet Lowe, Director of the Union of South Africa's Bureau of Archae-



▲ Inside the Paul Loewenstein Cave. Some eighteen feet below the modern level, Philip V. Tobias, research student, works near the beginning of the Early Modderpoort layer. The many implements found in this most ancient level are placed in the early Neolithic Period. The prehistoric natives may have begun painting during this time, but as no examples have been found in the excavations, Prof. van Riet Lowe and his assistant B. D. Malan are skeptical. Above the Modderpoort is a four-foot layer that is culturally poor, then a four-foot layer containing many fine blades and hearths, and finally what is called the Free State Wilton culture

◀ Another view inside the Paul Loewenstein Cave, showing Philip V. Tobias and B. D. Malan at work. The Early Modderpoort layer is the deepest and richest in implements, but it is only one foot thick

➤ Sifting the dust of ages for relics of the Modderpoort culture in the Paul Loewenstein Cave. It is Prof. Lowe's opinion that the cave was first inhabited 10,000 or 15,000 years ago. One painting on the cave wall represents a whale, although the ocean is 200 miles away. But none of the paintings are below the present floor level

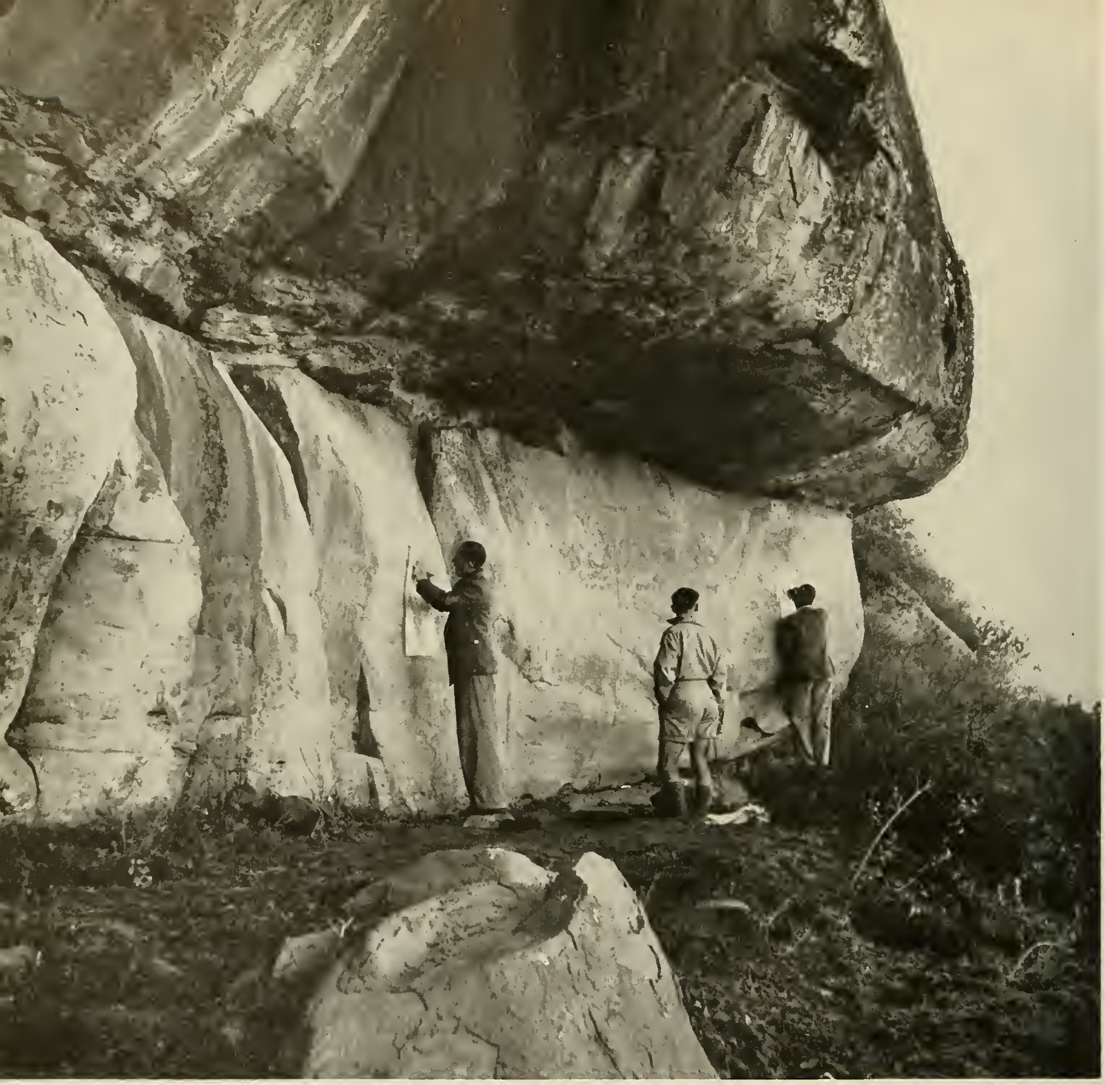
➤ Sorting the specimens showing human workmanship. Material from different levels is, of course, kept separate

ology. The actual caves may be two, three, or four times as numerous, since most of the farms contain more than one site. Professor van Riet Lowe and his small staff are still adding to the list.

Many of the sites are what are called rock shelters—shallow caves in the face of sandstone outcrops that jut from rolling hillsides. Some of them are no more than a yard or so deep, while others may extend well back into the rimrocks. Their distribution roughly follows Africa's "Great Escarpment," the edges of the 5000- to 6000-foot plateau that was pushed upward in the geological past. The escarpment is like an immense fishhook whose eye is in Ethiopia and whose shank stretches southward through the highlands of Tanganyika and Kenya to South Africa, where the curve of the hook follows the edge of the continent around and past the Cape of Good Hope. The barbs of the hook lie in southwest Africa and Angola where the highlands begin to taper down into the damp, torrid basin of the Congo. The greatest known concentration of rock paintings lies along the heel of the hook in South Africa, and it is there, too, that the prehistoric artists left their best works.

The paintings in the caves vary tremendously both in brilliance and number. In some caves there are relatively few, while in others the 40- to 50-foot-long walls may be covered with frescoes so that they look like huge animated panels. A great many of the caves contain paintings that have been done on top of other paintings—palimpsests, to apply the word that is used for manuscripts and tablets showing the work of more than one period. These overlapping paintings are particularly useful to the archaeologist, because they enable him to determine which type of art was the earliest.

In subject matter the paintings cover a wide range and show the prehistoric artist to be quite thorough in representing his surroundings. A great many paintings are of animals—the source of food—and in separate districts the types vary



▲ Tracing cave art in Orange Springs Cave

according to what must have been the distribution of game at the time. The Bushman painted the kudu, elephant, giraffe, rhinoceros, buffalo, eland, sable antelope, zebra, quagga, hippopotamus, leopard, lion, and almost every other known variety of animal in Africa. Bird paintings are occasionally found, and also the portraits of snakes and frogs. Trees and landscapes generally are rare, as are fishes, though in one cave, 200 miles from the Indian Ocean, archaeologists did find a painting of a school of dolphins.

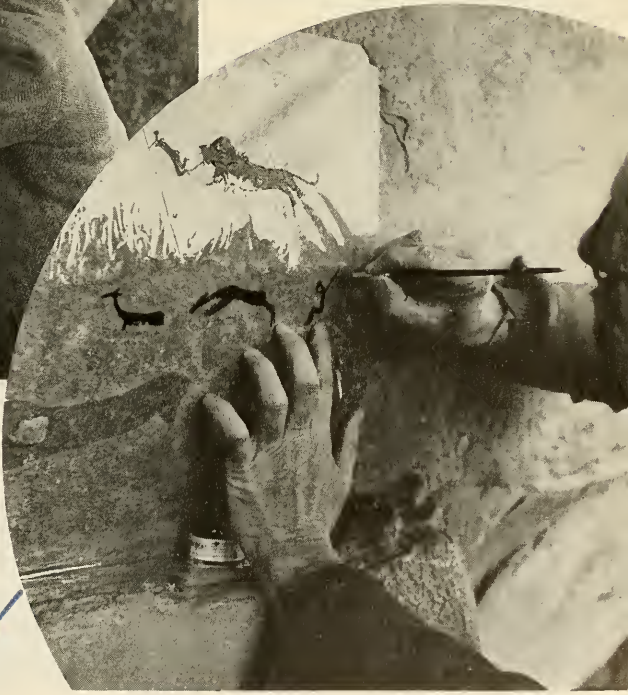
Nor did the rock artists omit humans. In almost all the caves there are big and little drawings of the people in their daily activities —hunting, at war, occasionally fishing, dancing, and a few that ethnologists believe are portrayals of funeral ceremonies and rain-making rites. Unlike most of the animal pictures, which are drawn with almost photographic fidelity, the human figures are impressionistic enough to satisfy any modernist. The Bushmen, who were notably short in stature, painted themselves as long, slender, and graceful. Some experts believe that the impressionistic portrayals resulted from a compensation psychology, while others think that the Bushman probably developed this rendition from watching his own shadow dance across the veld of Africa in the waning sun. At any rate, most of the human figures have the conspicuously fat buttocks (steatopygia) common to Bushmen, and this is one reason they have been called Bushman paintings. Yet the same characteristic has been noted in the Paleolithic rock paintings of the Pyrenees. This has led some archaeologists to consider the possibility that the Bushmen originated in Europe.

The painted figures themselves are amazingly lithe depictions of people running, dancing, and jumping and are done with the same keen perception of the fundamentals of movement that mark the Bushman's paintings of animals. They are, as the Abbé Henri Breuil, France's noted archaeologist, said, "a sort of moving picture film expressing throughout *joie de vivre*, the delight of being agile, fleet-footed, supple in sport and dance, deft in shooting arrows . . ."

Techniques, too, vary widely, and the studies made so far show a definite continuity in time. That, at least, was the opinion of the Abbé Breuil. The earliest rock paintings were monochromes, or single-color sketches, generally of animals in simple profile, much like the artwork of a child. From that approach, the prehistoric artists developed the use of two and more colors. At the same time, there was also a definite continuity in their ability to paint, which developed to the point where many of the paintings show an amazing rhythm of line, the already mentioned perception of movement. Finally, we note the beginnings of technical artistry such as foreshortening, perspective, composition, and rudimentary modeling, which are seen in polychromes where the prehistoric artist used shading in different colors.

Many of the paintings even today are still quite bright and clear, though there are thousands that have faded through the years until they are thin and shadowy. But the permanence of the Bushman's paint is amazing, and in many of the shallower rock shelters, even though little protected from the wind and weather, there are still clear paintings. The Bushman painted chiefly in shades of red, brown, and maroon, in black, white, and yellow—colors that were derived from mineral ores. The reds and browns were made from hematite, the white from zinc oxide and bird droppings, the yellow from iron pyrites, and the black chiefly from the charred wood of their campfires. They ground the minerals and mixed them with animal fat or bone marrow, which must have given the paintings when they were new an excellent brilliance and gloss. The Bushmen generally used brushes made of feathers, though there were variations in materials and equipment, just as there were in techniques. There are indications that some spread the paint with their fingers and that others used specially prepared tendons as brushes.

▲ Prof. van Riet Lowe uses transparent film for recording the paintings. He has just traced a little man fleeing from a charging lion. A few of the frescoes that were threatened with destruction have been given museum protection, but countless thousands are not even recorded



➤ When the painting has been traced as shown here, it is transferred to linen paper

The various developments in technique and materials were no doubt slow. Some must have taken hundreds or thousands of years. The peak of Bushman art was reached in the centuries before the bands of Little People were decimated by the invasion of new races from the outside—first the Hottentots pushing down from the north along the west coast, then the Bantus from the north along the eastern escarpment of Africa, and finally the Huguenots and the Dutch pushing northward from the Cape.

Archaeologists believe that the last Bushman artist finished his final painting about 100 years ago. In one cave on the eastern edge of the Orange Free State, they found a crude rock painting that unmistakably depicted the Voortrekkers, the pioneers of South Africa who migrated northward from the Cape to escape the control of the English between 1835 and 1840.

But exactly when the art of rock painting began and just who began it is still one of the great enigmas. Anthropological studies so far indicate that the Bushman, who finally gave way to invaders, was at one time himself an invader of the southern end of the Dark Continent. That was well over 1000 years ago, according to Professor Schapera's estimates in his studies of the Bushman and the Hottentot, *The Khoisan Peoples of South Africa.*

That there were earlier civilizations than the Bushman there is little doubt, but of them little is now known. Recently one excavation revealed what archaeologists believe to be a skeleton of one of those pre-Bushman races. They labeled it "Boskop Man." Another search produced the skeletal bits of another prehistoric man, which they named the "Strandlooper" and which showed evidence, according to Professor Schapera, of "an occasional amalgamation" between the Bushman and the Boskop.

But whether it was the Boskop Man, the Strandlooper, or some entirely unknown race of primitives that was responsible for the earlier rock paintings is still a matter of conjecture. The Bushman and Boskop men actually are relatively recent in the archaeological scale of time, and yet paintings have been found in caves all along the escarpment of Africa.

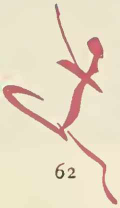
"The physical condition of many of these panels show them to have been at least sub-fossil, many of the figures being difficult to see, their color has sunk into the rock," Abbé Breuil observed. "Their physical state is just as fossilized as that of the Upper Paleolithic rock paintings and the Neo-Eneolithic ones of the Iberian peninsula . . ."

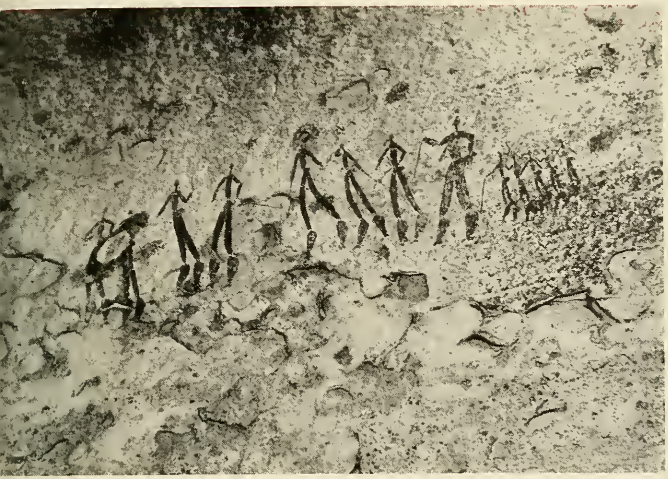
Lately, excavations in the Paul Loewenstein cave near Ladybrand, in the Orange Free State, brought to light bits of yellow ochre of the type used in the earliest paintings. They were found in a layer that Professor van Riet Lowe estimated to be between 10,000 and 15,000 years old. But whether the ochre was used for rock paintings or body adornment is still conjectural.

A few of the rock paintings present the ethnologists with fascinating puzzles. One painting in a cave in Southern Rhodesia shows a group of white people, which from their dress appear to be ancient Greeks, busy with their baths. Still another sketch in southwest Africa near Windhoek is of a white woman, whose shoes, dress, and posture recalled to the Abbé Breuil the "statuettes and frescoes of Knossos in ancient Crete." In other caves in the southeastern part of South Africa are files of white-faced, bearded soldiers who wear shoes and sometimes conical helmets that suggest the ancient civilizations of the Mediterranean.

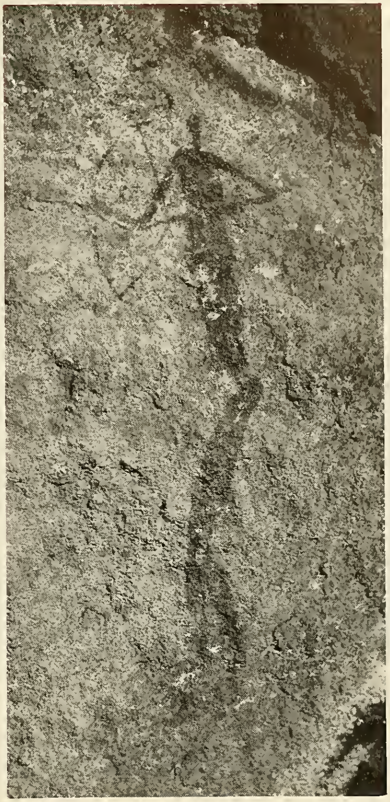
"These various scenes," the Abbé commented, "seem to me a reflection in Bushman art of the passage of columns of prospectors coming from the Persian Gulf at the time when the antique civilizations of Nineveh and Babylon and northwest India, flourished. It is impossible to say more. All these 'exotic'

➤ BACK in his office, Prof. van Riet Lowe at work on tracings from a cave in Mont aux Sources, so named because it is the source of many rivers in the Union of South Africa



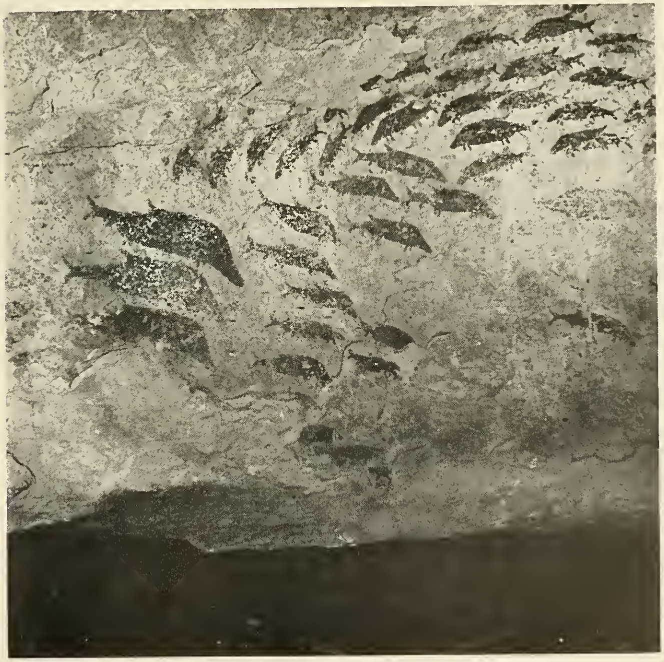


▲ AN EARLY BUSHMAN PAINTING thought to represent a "Praying Mantis" ceremony. The mantis in human form is a grotesque totem or fetish, apparently connected with rain-making rites. Orange Springs Cave, near Ladybrand, Orange Free State



➤ A BUSHMAN PAINTING of a man with a bow and arrow. Its estimated age: less than 1000 years

▼ A SCHOOL OF DOLPHINS painted by Bushmen on the wall of a cave 200 miles from the sea, on the Uysberg Farm, near Ladybrand



pictures belong not to an opening state in South African rock art but to the peak of its expansion, throwing back farther still its origin beyond the 3,000, 4,000, or 5,000 years of the ancient historical civilizations to which we have referred."

These mysteries are only part of the uncounted, unanswered questions that face the small assemblage of experts studying them. When and if a complete study of the thousands of sites is ever made, many more enigmas will undoubtedly be uncovered. It is a fantastically big job—one that has its limitations in time, because every additional year of wind and weather subtract a little more from the clearness of the paintings. Wind and sand, sun and water, heat and cold, already have bombarded untold numbers of the earlier paintings into unrecorded oblivion.

Readers are referred to a previous article on this subject by Nels Nelson, in the November, 1937, issue of NATURAL HISTORY.

OSPREYS *of Ventana*

A voyage in the Gulf of Lower California leads to close acquaintanceship with the fish hawk, a bird that harms no one and should not be harried out of existence

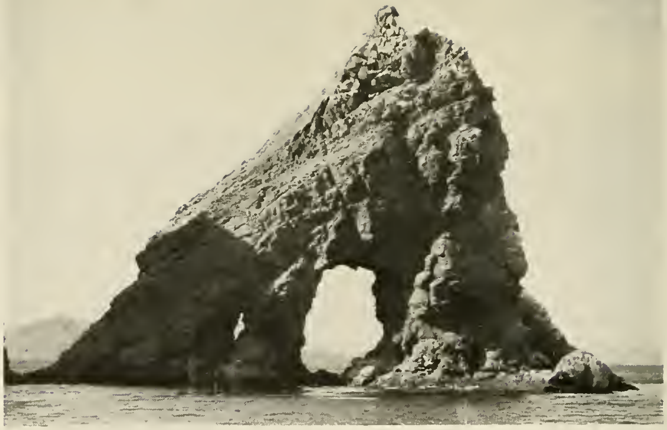
By Lewis Wayne Walker

Photographs by the author

▲ THIS YOUNG OSPREY was already showing the defiant spirit of its parents, who even put a dent in a flashlight reflector left in position for remote-control photography

A HUNDRED miles south of the California-Arizona border lies the tip end of the Sea of Cortez, a tremendous body of water dotted with islands, which, in turn, are dotted with the nests of ospreys.

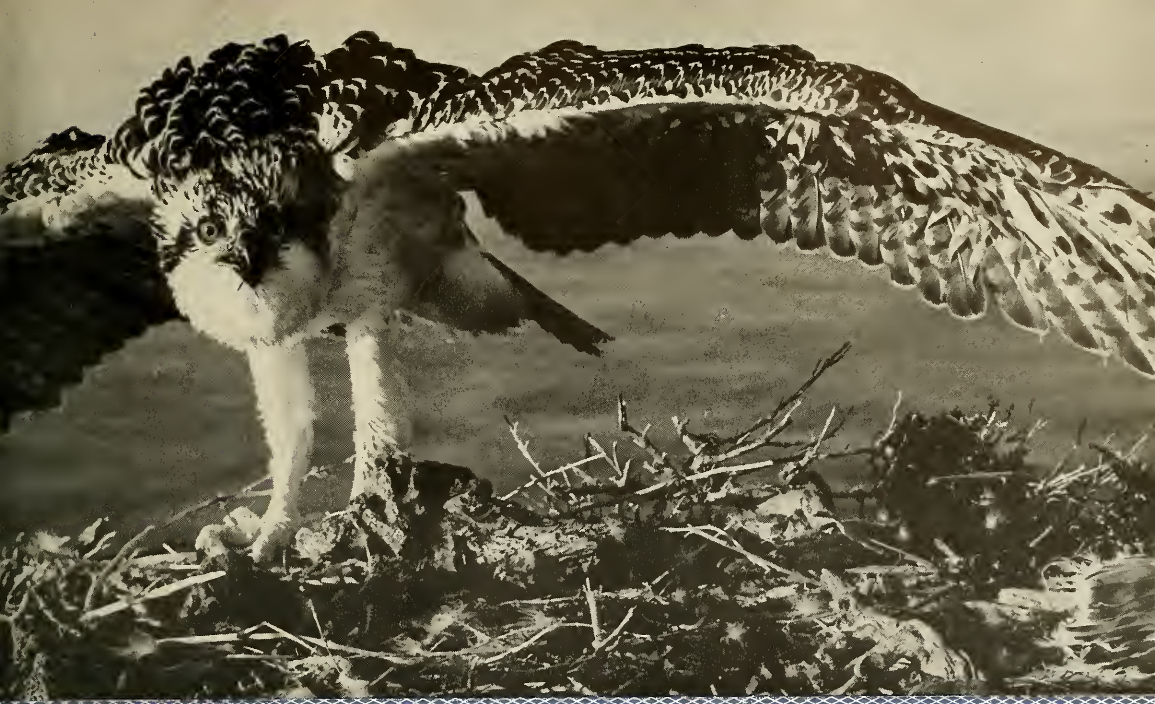
These impressive birds were formerly widely distributed throughout most of the tropical and temperate world. Some people may associate them with tree-bordered lakes, but actually they are as much at home on a scorching desert sea coast as elsewhere, a fact proved by their abundance along the full length of the Gulf of California. The vegetation of the region is meager and mainly limited to stunted elephant trees and giant cardon cactus, the Lower California saguaros. Lizards, rattlesnakes, and pack rats form the bulk of the islands' terrestrial animal life, while giant sea turtles and graceful porpoises play in waters which are rarely disturbed by churning propellers.



▲ A NATURAL CITADEL selected by the adult birds for their nest—a rock appropriately named Ventana, or "window"

In a few localities the ospreys nest in the crotches formed by the branching arms of the giant cactus, but the birds far outnumber available plants, and so most of them are forced to place their bulky nests on rocky pinnacles. From a photographer's point of view, any one of these nests would be an ideal camera subject, but there are so many from which to choose that a traveler is baffled by their numbers. To a certain extent the legendary "mañana" complex of the country takes over, and I passed nest after nest, deciding each time to return on the morrow. Then I found Ventana, the "window-rock."

This tremendous triangular pile of rock reared in the air a hundred feet wide at the base and as many feet tall. A stone's throw away was a larger island, one of the many in



▲ **The young bird**, even at this age, was not reluctant to charge the author

the beautiful bay of Bahia de Los Angeles. Winds and tidal current have worked on Ventana, but instead of wearing the rock around its circumference, they have tunneled a hole through its middle, creating a natural arch as a perfect frame for the bay and the hills beyond. At its topmost point a bulky pile of sticks jutted up for another five feet to form the prize eyrie of them all—a rugged beauty that words cannot adequately describe.

The size of this nest was indicative of long occupancy by ospreys, yet my first visit convinced me that it had never before been molested by humans. At every step of the steep climb an avalanche of loose stones was started, and I literally carved a trail to the summit. Within a slight depression on top of the pile of sticks reposed two chocolate mottled eggs.

All during my ascent, the adults had flown overhead, constantly whistling defiance; but as I climbed and finally reached the base of their home, their vocal threats changed to action, and every ten or fifteen seconds I was forced to duck the reckless attacks of the nesting birds. They missed me by mere inches and became braver with each dive. Finally, when air turbulence ruffled my hair, I picked up a two-foot stick and held it above my head for protection. It was promptly knocked out of my hand and into the water far below.

The adults usually worked in conjunction like a well-rehearsed team, but I noticed that there were short periods when only one bird guarded the nest. Then, each time that the missing mate returned to repeat the diving tactics, I would be showered with a fine spray of water from dripping feathers. This water spraying was just a by-product of the bird's method of keeping cool in the heat of constant attacks. When, through exertion, body temperature "reached a boiling point," the bird would soar off on a long, fast glide. Just above the surface it would dangle its long legs and create a filmy blanket of spray. These nonstop aerial baths often left a wake of a hundred feet or more in length. The whole procedure of repeated dives and short "time outs" was reminiscent of a prize fight with its three minutes of strenuous battle and a minute of refreshing rest.

A month later I again visited Ventana, and in place of the eggs there were twin young. Despite their tender age of less than a week, the chicks were obeying commands of their parents, evidently given as my boat approached the rock. Both of the young were flattened against the debris as though pressed into place with a weight, and although their eyes were half open and watching my movements, they gave no other sign of life. One that I picked up and rolled on its back remained rigid for many minutes. Then it gradually twisted its neck into a half-turn and placed its lower mandible flush with the nest. Dust and fish scales, dislodged when I set up the camera tripod, floated about the dry platform, and some of these particles settled in the open eyes of the young. Still no movement was to be seen, although such irritation would have been unbearable to a person and would have caused one to break the sternest of parental commands.

After the camera was set and

focused on the nest, I retreated toward the base of Ventana with the electric remote-control cord in my hand. As I inched my way down, Chappo, the boatman, gesticulated wildly and pointed to the nest. I paused in my descent and glanced back at the eyrie to see camera and tripod dangling over space, held aloft by an electrical plug and a cord that had snagged on a projecting boulder. Later, when I gingerly pulled the equipment to the top, dents and talon marks on the reflector showed that the dives of the adults were not always intentional misses.

A month later and after 400 miles of island-hopping in the central section of the Gulf, I returned to Ventana once more. From a distance, the twin young, almost as large as their flying parents, could be seen standing in the nest. At the first whistled warning, they fell flat on their breasts in the same freeze that they had used as chicks. But with growth and strength had also come independence, and now when I turned one over, he flopped right side up and then with open wings tried to rush me off the nest. The adults, so worried on previous visits, were now more tolerant and were content to circle 50 feet above and whistle advice to their offspring.

Two hours were spent in the vicinity, and throughout this period a fourteen-inch mullet was constantly carried in the talons of one of the parents. This fish, almost half the bird's length, was handled in an effortless manner and was carried headfirst into the line of flight to minimize wind resistance. Later, as our boat left the ospreys' domain, the burdened hawk was seen to zoom up and above his flying mate and then release his hold on the prey. As it hurtled downward, end over end, the lower bird snatched it out of the air and flew in to feed the young.

At an age of about a month and a half, the young were seen practicing flight on the hogback ridge, and a few days later they were found on the beach of the larger island near by. The parents spent most of their time circling lazily over the bay on the watch for finny prey in the waters below; and when a fish was sighted, a bird would hover over the spot until it approached the surface and then go into a speedy, headlong dive. When 25 feet from the water, the wings would be raised and talons extended to maximum length. A fraction of a second later the bird would almost disappear from sight, completely enveloped in a shower of spray. After a short struggle, with wildly beating wings, the hunter would once more become airborne. On regaining altitude, the fish would be deftly shifted to its headfirst position and then taken to the beach and fed to the waiting young, soon to be on their own.

∀ YOUNG raised in captivity and without instruction from their parents have developed the osprey technique of catching fish. The fish is usually carried headfirst to reduce wind resistance

TURRET EYES

The daddy longlegs has eyes in a turret, but still he can't see very well

By Edwin Way Teale

Photographs by the author

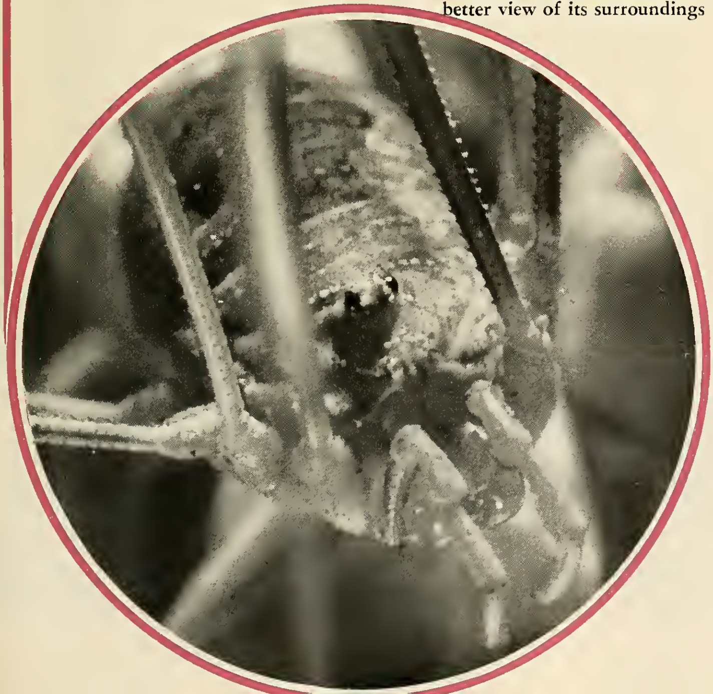
▲ A daddy longlegs, or harvestman, on the blooms of a white funkia

IF a daddy longlegs walked as we do, its body would be lifted well above the ground at the top of its slender stiltlike legs. It would form a kind of natural lookout tower. Instead, it moves along on legs that are bent, its "knees" rising high above its seed-shaped body. The body bobs along almost touching the ground. In this position, the grandfather graybeard, as it is sometimes called, is better able to detect its food by touch and taste. But it is handicapped in the matter of seeing around it, for its low viewpoint limits its horizon.

A close examination of one of these familiar creatures reveals the curious position of its eyes. They are located in a little tower or turret that rises from the upper side of the body like a conning tower on a submarine. This turret holds two eyes, one facing to the right, the other to the left. In this position, the eyes have increased effectiveness. They are lifted above the body, situated in an open space, better able to see what is going on around them.

And the daddy longlegs needs all the aids to better vision that it can possess, for its two organs of sight are of extremely low efficiency. They are hardly better than the simple eyes, or ocelli, that are found between the great compound eyes on the heads of many insects. But this creature, like most arachnids, is largely nocturnal. The main function of its eyes is to detect the difference between light and dark. So, even though it carries a living lookout tower about on its back, the so-called harvestman probably sees—in varying degrees and shapes—only masses of light and dark in the world about it.

▼ Close-up of a harvestman, showing the little turret that rises above the creature's body and gives it a better view of its surroundings



March of the GIANT AFRICAN SNAIL

Its sudden advance around half the circumference of the world is a serious menace to agriculture

By R. Tucker Abbott
Assistant Curator, Division of Mollusks, U. S. National Museum

The sergeant was enjoying the cool of the evening as he drove his jeep down the steep and winding jungle road. Although orders were still in effect to drive at a snail's pace on Saipan's mountain roads at night, he apparently had no need of reducing speed more than was required to make the sharpest turns. On one of those rare, straight stretches, the jeep picked up speed. Suddenly, the sergeant saw that the road ahead was littered with large stones. He braced himself for the jolts and applied his brakes. But under the wheels the stones popped and crunched like hens' eggs. Then the jeep skidded, and the beams of the headlights tangled with jungle vines and went out.

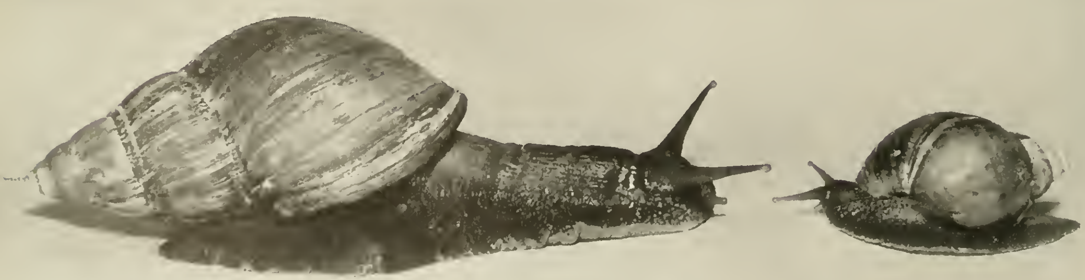
The dazed sergeant crawled out of the ditch and limped back onto the road with flashlight in hand to investigate the "stones." A long whistle of wonderment escaped his lips. These were not stones. They were dozens of huge, crawling snails, many nearly half a foot in length! All were marching across the road, and the smeared carcasses of a number of them marked the skid trail to the ditch where the wrecked jeep lay on its side.

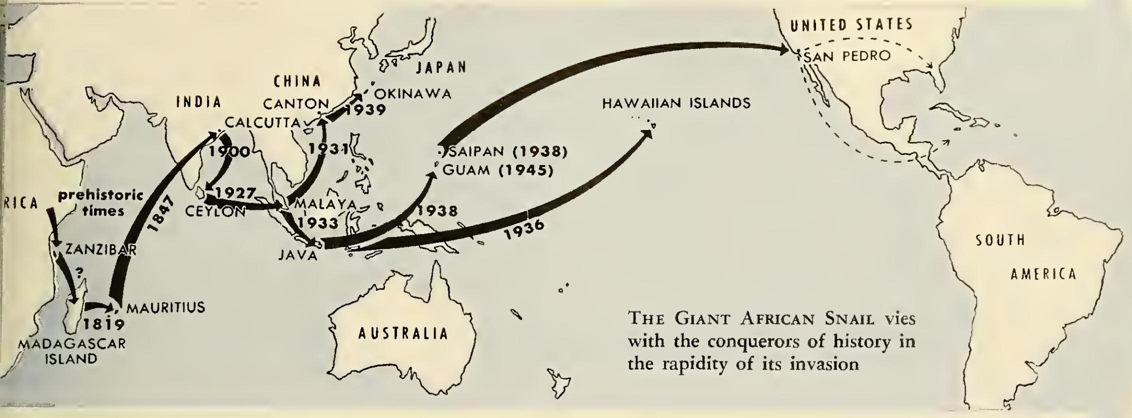
The strange story of the swarms of giant snails found by the sergeant and others on Saipan Island after its capture from the Japanese has its beginning some 8000 miles to the west of the Mariana Islands. Before man began his extensive trading voyages throughout the Indian and Pacific oceans, the giant African snail (*Achatina fulica* Ferussac) was limited to the Island of Madagascar and probably the mainland of Africa. The very early history of Achatina's march around half the face of the globe is obscure; but since 1803, man has recorded its introduction into a score of foreign lands, with the latest invasion taking place in southern California.

The sudden appearance of snails of such unusual size, the rapidity with which they reproduce, and their destructiveness to succulent plants and young sprouts have caused man to turn battle against these molluscan invaders in a score of places around the world. Alarming destruction to truck crops in the Mariana Islands and the recent accidental introduction of this snail into the United States have added a new chapter to the story. Will

▼ **In size**, it is a veritable nightmare of a snail. Extended from its five-inch shell, it may measure nine inches or more overall. (*Achatina fulica* Ferussac)

Photo courtesy of Ernest P. Walker





THE GIANT AFRICAN SNAIL vies with the conquerors of history in the rapidity of its invasion

other chapters soon be added, such as "Giant Snails Raze Florida Tomato Crops" or "Cubans Battle Giant Snail Visitors from the United States"?

The menace is so real that the National Research Council, at the request of the United States Navy and its Office of Island Governments, has recently set out to find some solution to the problem. Already, Dr. Francis X. Williams, a scientist renowned for his successful fight against insect invaders of the Hawaiian Islands, has been sent to the home of the Achatinas in tropical Africa. His job is to learn as much as possible about the snail's habits and natural enemies. What he discovers will be used in our all-out attack on the snail in the Pacific.

One of the advisers to this project, and without question the leading authority on African land snails, is Dr. Joseph Bequaert, who was formerly on the staff of the American Museum of Natural History and is now a curator at Harvard's famed Museum of Comparative Zoology. The largest collection of Achatina snails, including nearly all of the known species, is housed at Harvard University. Of the several dozen species of Achatinas, the Pacific invader is by no means the largest; it has gained the name "giant" only because of its size in relation to the smaller snails of India and the East Indies. *Achatina achatina,* the King Kong of land snails, has perhaps the more rightful claim to the name "giant African snail"; but probably because of its special environmental or food requirements, it has never successfully invaded other lands.

The first published record of *Achatina fulica's* appearance outside of Africa and Madagascar was made by the French naturalist L. A. Bosc, who in 1803 recorded it from the Island of Mauritius, some 700 miles east of Madagascar. Also about that time, the French governor of Reunion Island dispatched a ship to Madagascar to obtain living specimens for his gardens. It appears that the favorite young lady of the governor had acquired a taste for snail soup, which in those days was considered a sovereign remedy for tuberculosis.

Responsibility for the snail's first introduction to the mainland of Asia can be traced to the well-known malacologist W. H. Benson. While visiting a friend to collect mollusks in Mauritius in 1847, he became sufficiently interested in these giants to bring back living specimens to Calcutta, India, where he released them in the garden of the Bengal Asiatic Society.

Since Benson's day the giant African snail has made a steady march eastward, with serious outbreaks occurring in the Seychelle Islands prior to 1868 and in Ceylon in 1900, where it attacked young tea plants. It made its presence known in Perak, Straits Settlements, in 1927 and in Malaya in 1928, where it destroyed thousands of young rubber plants. By 1930, it was in the gardens of Singapore and a year later in Southern China. It hit the Rhio Archipelago, Netherlands East Indies, in 1933; then Java in 1935; Palembang, Sumatra, in 1936; and Siam before 1937. The snail has appeared from time to time in the Hawaiian Islands, but thanks to the vigilance of Dr. C. M. Cooke, of the Bernice P. Bishop Museum, and Dr. C. E. Pemberton, colonies introduced have been stamped out each time before the situation reached the epidemic stage.

The Japanese introduced Achatinas to Saipan and Tinian Islands in the Mariana Islands for food purposes some time before 1940. Although the Japanese were very fond of Achatina stew, the natives did not acquire a liking for it. When American troops occupied these islands in 1945, the snails were so abundant that driving was dangerous because the roads were made slippery by hundreds of crushed snails. The author has seen as many as 50 large Achatinas clinging to a small 10-foot tree on Saipan Island. Dr. E. E. Green, in 1911, reported a similar condition in Ceylon, where 227 snails were counted on the stem of a coconut tree. The ground beneath was covered an inch deep with excreta.

In 1946, when pandanas leaves were being shipped from Saipan to Guam for native handicraft, the snails soon appeared on the outskirts of a village not far from Agat on the west shore. No serious effort was made by the authorities to control the invader, and by 1947 the colony had enlarged and spread over most of southern Guam. At present, a similar epidemic is raging in the Palau Islands.

United States is the most recent port of call for Achatina, living adults having been found in gardens in San Pedro, California. The theory has been advanced that eggs or estivating adults were brought in on army vehicles from Tinian Island soon after the war. It would be regrettable indeed if the snails established themselves in California's great truck-farming areas. Fortunately, the climate of that state is not considered to be entirely ideal for the snail. In Malaya, agriculturists were concerned as much with the ability of the snail to mechanically transport common plant diseases, such as the "root disease" of sugar cane, as they were with its destructiveness to sprouting rubber plants.

Adult Achatinas seem to prefer rotting vegetation, fallen fruit, and even human excreta as the main part of their diet, but younger snails take an active part in attacking succulent vegetables and the sprouts of certain economically important plants. In Ceylon, where the rocks are almost purely granite, there is no limestone, and doubtless because of this the snails have developed a passion for whitewash. They crawl up buildings in order to lap it off; and this is now turned to account in keeping down the pests. Little bags of poisoned whitewash are hung in spots where they are likely to find and eat it.

Biological control by the introduction of natural enemies or diseases that keep the snails in check in their native Africa is a method that holds great promise, but offsetting this is the gamble of a biological backfire. It sometimes happens that the controlling agent successfully checks enemy No. 1 only to become a menace to harmless creatures. There are small carnivorous mollusks in Africa that attack Achatina snails. If introduced to the islands, would they not only eliminate the African giants but turn to wipe out the beautiful Partula snails, which are used extensively for native jewelry?

Other enemies of this species of Achatina have been observed in several countries, but their effectiveness in control has been negligible. In Africa, large lizards have been known to feed upon them. In Ceylon, the common Pond Tortoise (*Nicoria*) is the only animal that has been observed to attack them. In the East Indies, rats have occasionally gnawed open the shells. The larvae of the Indian Glowworm (*Lamprophorus*) will attack and devour young Achatinas at night, but their inability to check their numbers is attested by the fact that by 1910 large colonies were fairly common over most of northern Bengal.

One cannot always predict how one particular species will behave in a foreign land, whether it be snail, monkey, or man. Achatina is almost exclusively a ground dweller in Africa, yet in the East Indian and the Pacific Islands it has taken to arboreal habits in great measure. Whether this particular paradox is due to the development of a new strain of this species or is brought about by the necessity of seeking new tree-dwelling foods, such as lichens, is not known.

There is still another approach to their control, one that calls for the combined planning of the biologist, fisheries expert, and economist. It has been suggested that small canneries be set up in the islands where the Achatinas could be harvested, prepared for canning in the manner of squids, and shipped to the Japanese markets. It is possible that their gastronomic appeal might vie with the most favored of Japanese seaweeds, holothurians, and octopi.

Temporary measures to protect crops and gardens have met with varying degrees of success. A price was put on Achatina's head in Malaya, and in a single day several thousands were collected and carried out to sea. Unfortunately, the wind turned to an unfavorable quarter and washed most of them ashore alive! It was soon learned that piles of collected snails had to be buried or burned with the aid of gasoline. Poultry dealers introduced them from Singapore to Sarawak for chicken food, and two years later a program of eradication had to be started. In fifteen days, half a million adults and twenty million eggs were destroyed. In a year or so, the snails were as plentiful as before. Rubber planters developed poisoned bait-balls of rice bran and a poison of a compound of metaldehyde. Miniature tents of corrugated iron sheeting were put over the bait-balls to prevent hardening by the sun and melting by the rain. Their success was moderate. DDT is likely to have little or no effect on snails, since mollusks lack the chitin for which that chemical has such an affinity in the case of insects.

Achatina's powers of reproduction are excellent. In a year, the young are old enough to begin laying eggs. Usually 300 eggs are laid at one time, and it is believed that the snail repeats the operation every few weeks during rainy spells. The round, yellow, pealike eggs are laid at night under protective leaves on the ground in a mucous glob about the size of a cucumber. The adults have both male and female reproductive organs in the same individual, so that each fully grown snail contributes to the increase of the colony. Three hundred eggs at one sitting is by no means startling for a mollusk; a single oyster sometimes reaches the 60,000,000 mark. What prevents the ocean from filling with oyster shells in a few years is the enormous death rate among the young. Apparently, in the Pacific Islands where natural enemies are absent, the death rate among young giant African snails is quite low.

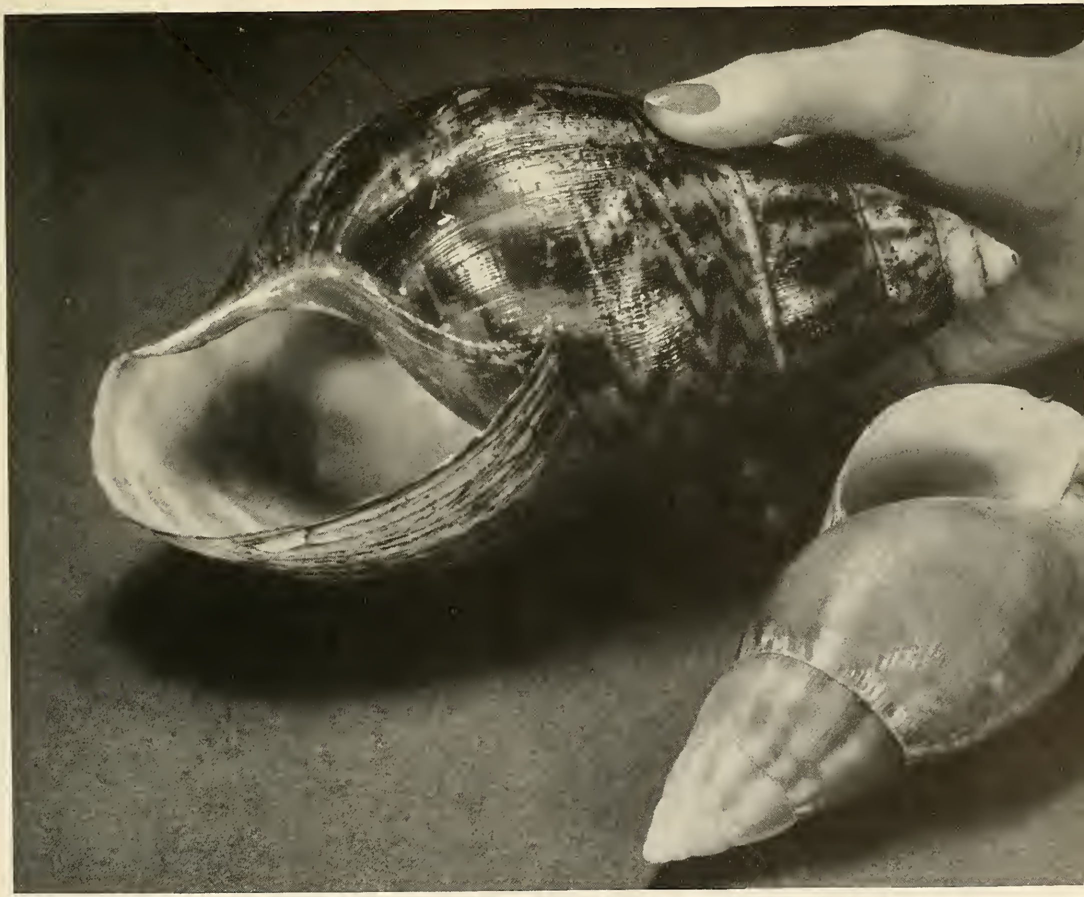
A "worm's eye" view of the animal of the Achatina snail is not particularly attractive. The moist, rubber-like skin of the body and face is granulose in texture, with a number of longitudinal furrows running along the neck. The color of the skin is a subdued brownish black. Mounted on the head are two pairs of feelers: a pair of short tentacles and, above them, two larger eye peduncles. At the tip of each of the latter is a round, bulbous eye. The fleshy peduncles are constantly moving from side to side and changing in length. If the eye is touched, the snail immediately shrinks the peduncle to almost one-fourth its original size. Oddly enough, the creature accomplishes this by pulling the eye down into the peduncle itself, just as you might turn a stocking inside out.

If we could imagine an Achatina snail as large as a cow, we would undoubtedly be horrified at its ability to chew and engulf vegetable matter. The mouth is armed with a horny jaw, behind which is an impressive set of over 80,000 tough teeth. The individual teeth, which are arranged in rows along a tonguelike ribbon, are made up in the form of small oblong blocks, each bearing a strong pointed hook. At times, when the mouth of the snail is pressed firmly against a piece of glass, the glint of flashing teeth can be seen as the ribbon moves back and forth.

While protected by the mucous matrix, the eggs are rubbery to the touch, but if separated from this moist, protecting sheath, their outer calcareous shells become extremely hard. Their bouncing qualities on the laboratory table are equal to those of golf balls. Yoshio Kondo, one of Hawaii's mollusk experts, has carried out a number of interesting experiments with the eggs and young of Achatina. Not the least strange of these were the "ship-in-a-bottle" experiments. Jars and bottles of several sizes and shapes were laid on their sides, and miniature gardens were carefully cultivated inside. A newly hatched Achatina snail was then introduced into each bottle and allowed to grow. For months water and food were passed through the necks of the bottles to the ever-growing snails. Their shells increased normally until no more room was available. Many of them continued their growth to take on bizarre, elongated shapes. When the desired oddity in size or shape had been acquired, the bottle, garden, and snail were boiled a few minutes in water and then meticulously cleaned of all meat, soil, and vegetation. Result: a beautiful giant African snail shell enshrined in a bottle.

▼ A CLOSE RELATIVE of the destructive snail is even larger, as shown here. The one in the hand is *Achatina achatina*

AMNH photo



New York Zoological Society photo by Sam Dunton

▲ STATELY SCALARES swim among sprigs of water sprite, *Vallisneria,* and *Cryptocoryne* in a small aquarium

The Myth of THE BALANCED AQUARIUM

If you have been planting vegetation in your aquarium on the ancient theory that your fishes need the oxygen it produces, you will be interested to know how it is really affecting them

By JAMES W. ATZ
Assistant Curator, New York Aquarium, New York Zoological Society

Drawings by G. MILES CONRAD

THE idea that the animals and plants of an aquarium balance each other in their production and consumption of carbon dioxide and oxygen was a little over 100 years old when it was proved wrong. Although it was disproved more than seventeen years ago, the myth of the balanced aquarium still holds sway—in the tropical fish fancy, in the schoolroom, and in the laboratory. Such is the power of the too felicitous phrase, the too trim theory.

Joseph Priestley was the first to demonstrate the reciprocal action of plants and animals on the atmosphere, when he showed that a limited amount of air in which rats were smothered would again support more of them after green plants had remained in it for a time. In 1777, he also reported that fishes affect the water in which they live in the same way that terrestrial animals affect the air surrounding them, although he apparently had not availed himself of Robert Boyle's experiments, performed a century earlier. Boyle showed that a fish breathes air dissolved in water, since it dies when its container is placed in a chamber from which most of the air is exhausted by a vacuum pump or when its glass is quite filled with water and so closely stoppered that it cannot enjoy the benefit of air.

Priestley paved the way for the fundamental work of Ingenhousz, de Saussure, and Senebier on plant physiology and of Lavoisier on the chemistry of animal respiration. Thus by the first decade of the nineteenth century it was well established that plants, like animals, respire, taking in oxygen and giving off carbon dioxide, but that in the presence of strong enough light this function is far overbalanced by the assimilative one, later called photosynthesis, in which carbon dioxide and water are consumed and oxygen released.

We realize today that almost all the oxygen in our atmosphere results from the photosynthesis of plants, so the savants of Priestley's time were not incorrect in emphasizing the far-reaching importance of this plant-animal relationship. But they gave it a teleological twist, using it to illustrate the marvelous goodness of the world in which man lives. "From these discoveries we are assured that no vegetable grows in vain," declared Sir John Pringle, President of the Royal Society in 1773, "but that from the oak of the forest to the grass of the field, every individual plant is serviceable to mankind; if not always distinguished by some private virtue, yet making a part of the whole which cleanses and purifies our atmosphere. In this the fragrant rose and deadly nightshade cooperate: nor is the herbage, nor the woods that flourish in the most remote and unpeopled regions unprofitable to us, nor we to them; considering how constantly the winds convey to them our vitiated air, for our relief, and for their nourishment."

This florid vein continued on into the cynical twentieth century, when J. E. Taylor wrote, in 1901, that "every teacher in physical geography now imparts to his class that the oxygen generated in the virgin forests of the Amazon valley may be brought by the wind to bring health to the fetid streets and alleys of crowded European cities, and that in return the carbonic acid breathed forth from our overpopulated towns may be carried on the 'wings of the wind,' to be eventually absorbed by the incalculable stomata which crowd the under surfaces of the leaves in the same forest-clad region!"

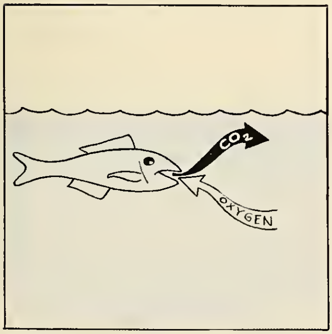
These were the compost-mixers for our myth; they prepared each successive generation with successively more fertile minds for its seeding and growth. Who, preoccupied with the world-wide implications of the balance between plants and animals, could suspect that so insignificant a part of the earth as a home aquarium would not conform?

The first aquarium: where and when was it devised? The word itself was not used to indicate a container of water with aquatic animals living in it until 1852; but before that, who was the first to keep fish captive in some small, water-containing receptacle? As far back as 2500 B.C., the Sumerians kept living fishes for food. The ancient Romans had pet moray eels and mullet, while the Chinese domesticated the goldfish in the Sung Dynasty (960-1278), but all these fishes were maintained in pools or ponds. There is evidence, however, that in some places in China goldfish were kept indoors in porcelain vessels during the winter months. Perhaps these were the first aquaria, although we cannot be sure.

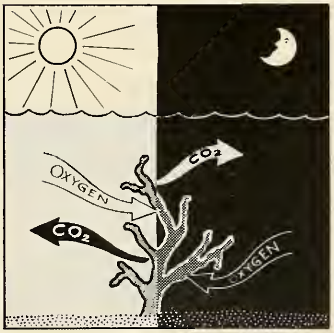
If we consider the aquarium properly to be only a glass or glass-sided water container, we can fix its origins a little more definitely. The earliest record of putting fish into glass containers comes down to us from the Romans of the first century. They did not do this for the purpose of keeping the fish alive, however, but to watch their change of color as they died.

The maintenance of fish in small glasses was still noteworthy enough in 1746 to warrant the publication of Fellow William Arderon's letter "on keeping of small fish in glass jars" in the *Philosophical Transactions* of the Royal Society of London; yet this was certainly not the first attempt to do so. According to Boyle, Guillaume Rondelet, a Renaissance student of aquatic life who died in 1566, once claimed that his wife had kept a fish alive in a glass of water for three years. Samuel Pepys, indefatigable recorder of minutiae, made the following entry in his diary on May 28, 1665: "Thence home and to see my Lady Pen, where my wife and I were shown a fine rarity: of fishes kept in a glass of water, that will live so for ever; and finely marked they are, being foreign." My Lady Pen, incidentally, was the mother of William Penn of Pennsylvania.

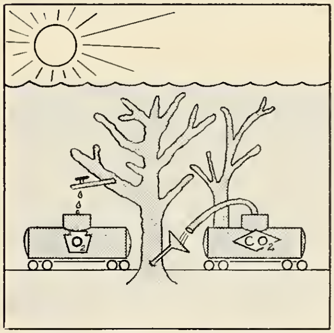
But the keeping of fishes as pets did not become a popular pastime until after the goldfish was widely introduced into England during the first half of the eighteenth century. At first they were maintained in ponds on the lands of the well-to-do. Sir John Hawkins, noted editor of Izaak Walton and Charles Cotton, wrote in 1760: "There has also been lately brought hither from *China*, those beautiful creatures Gold and Silver Fish...These fish are usually kept in ponds, basons and small reservoirs of water, to which they are a delightful orna-



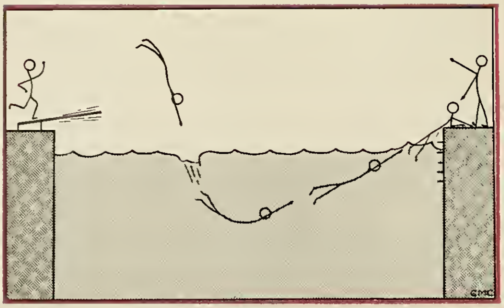
Fishes, like people, breathe oxygen (dissolved in water) and give off carbon dioxide



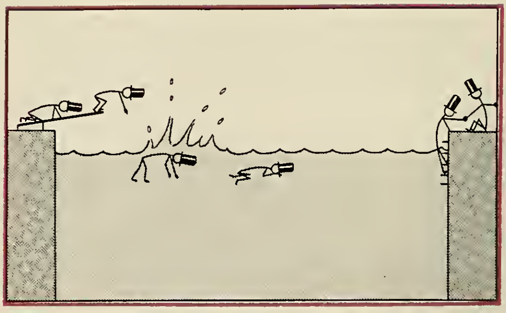
Plants use oxygen and give off carbon dioxide day and night, but in daylight an opposite process overshadows this



Under the influence of light, plants use larger quantities of carbon dioxide and give off larger quantities of oxygen



Oxygen escapes readily from water and is quickly absorbed by it



Carbon dioxide, unlike oxygen, moves sluggishly from air into water or vice versa

ment; and I have known a few of them kept for years in a large glass vessel like a punch-bowl. . . ." In the second and third editions of *The Complete Angler* which he edited, dated 1766 and 1775 respectively, the above footnote was repeated, but in the fourth edition, printed in 1784, Hawkins saw fit to alter it, stating that "it is now a very common practice to keep them in a large glass vessel like a punch-bowl. . . ." The Reverend Gilbert White corroborates Hawkins in Letter LIV of *The Natural History of Selborne,* based on an entry from his Journal dated October 27, 1782: "When I happen to visit a family where gold and silver fishes are kept in a glass bowl, I am always pleased with the occurrence, because it offers me an opportunity of observing the activities and propensities of those beings with whom we can be little acquainted in their natural state."

If we accept this evidence at face value, we can declare that between 1775 and 1784 the goldfish bowl became a popular household appliance in England.

The elements of our myth were now at hand; it only remained for someone to apply the principle of plant-animal balance to an aquarium by growing aquatic plants in it.

Looking at the matter in historical perspective, one is not impressed by the ingenuity of the idea or surprised that a number of people claimed to have stumbled upon it independently and more or less at the same time. The wonder is, perhaps, why no one hit upon it before. For it was not until after 1840 that aquarists began to employ aquatic plants in their tanks. Moreover, it was a French invertebrate zoologist, Charles des Moulins, who first claimed to have discovered that the presence of green plants in small containers of water kept that medium suitable indefinitely for small animals (planarians in this instance) and who attributed this effect to the physiology of the plants. Charles des Moulins was President of the Linnaean Society of Bordeaux, and he reported his experiments in the *Actes* of that organization in 1830.

Credit for the earliest clear enunciation of the benefits resulting from the interactions between aquatic plants and fishes should, however, go to the author of a chemistry textbook, William Thomas Brande. As early as 1821, his *Manual of Chemistry* stated: "Fishes breathe the air which is dissolved in water; they therefore soon deprive it of its oxygen, the place of which is supplied by carbonic acid; this is in many instances decomposed by aquatic vegetables, which restore oxygen and absorb the carbon; hence the advantage of cultivating growing vegetables in artificial fish-ponds." That this information should appear in a book on chemistry makes one wonder if it were not common knowledge among fish culturists of the time, but a search of the literature has failed to reveal even an allusion to it.

Perhaps this disjunction of knowledge explains why the five or six amateur and professional biologists who at this time came upon the idea of using plants to "purify" their aquaria, each claimed to be the originator of it and why they quarreled (albeit genteelly) as to who was the first among them to do so.

One of them, Robert Warington, later said that it was Brande's statement that had incited him to set up his experimental tank with goldfish and tape grass (*Vallisneria*). Warington was a chemist himself, and his was the first unequivocal exposition of the conception of mutual interdependence of the plants and animals in a small container of water. Both des Moulins and George Johnston, who had worked with sea water, marine animals, and seaweed previous to 1842, had been somewhat vague in their writings. Not so Warington. His paper, read before the Chemical Society of London early in 1850, is perfectly clear and could be used today as a summation of what practically all teachers, most aquarists, and many professional biologists believe: "Thus we have that admirable balance sustained between the animal and vegetable kingdoms, and that in a liquid element. The fish, in its respiration, consumes the oxygen held in solution by the water as atmospheric air; furnishes carbonic acid; feeds on the insects and young snails; and excretes material well adapted as a rich food to the plant and well fitted for its luxuriant growth.

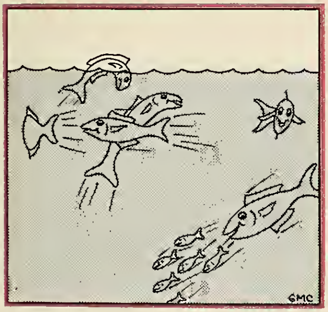
"The plant, by its respiration, consumes the carbonic acid produced by the fish, appropriating the carbon to the construction of its tissues and fibre, and liberates the oxygen in its gaseous state to sustain the healthy functions of the animal life, at the same time that it feeds on the rejected matter which has fulfilled its purposes in the nourishment of the fish. . . ."

The key word was "balance," and it appears in the writings of N. B. Ward, Philip Henry Gosse, Edwin Lankester, and Mrs. Anne Thynne, co-claimants for the honor of first applying the oxygen-carbon dioxide interactions of plants and animals to small aquaria. Probably the first to set up a tank containing both fish and plants with the idea of balancing one against the other was Nathaniel Bagshaw Ward, an English botanist, who originated the Wardian Case, that glass-sided box with ferns and other plants growing inside it so often seen in latter nineteenth century parlors. Whether it was this miniature greenhouse (admittedly not airtight) that gave Ward the idea for setting up his aquarium in 1842 was never made clear, either by him or his encomiastical son. At any rate, the father did not publish an account of his work until 1852. Ward was apparently indirectly responsible for the first public aquarium. His tank inspired a Mr. Bowerbank to set up one of his own, and this in turn gave David W. Mitchell, Secretary of the Zoological Society of London, the idea of an exhibit made up of a series of such tanks. This took form in Regent's Park as the Fish-house, which was opened to the public in the spring of 1853 and consisted solely of a number of standing aquaria, some with fresh, some with salt water, housed in a conservatory-like building.

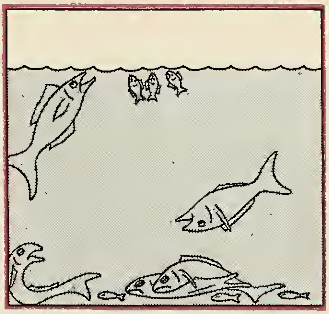
New York Zoological Society photo by Sam Dunton

▲ **Swordtail** (female above and male below). One of the most popular of the small, tropical, fresh-water fishes kept as pets throughout the world

Judging from the remarks of the times, the exhibition was a tremendous success. Moreover, it so stimulated the hobby of keeping fishes as pets that it became more or less of a craze. Dealers in tanks and aquatic plants and animals established themselves in London and Edinburgh. Prices for a ready-made home aquarium ranged from two shillings to ten pounds. The experience of one J. Paul was perhaps typical: "I saw the aquarium first at the Regent's Park Gardens, then in a shop-window in the City Road, and then—everywhere; and I at once determined to be the happy possessor of a tank. Alas," he continued, somewhat ruefully, "I knew not the penalty attendant on this worship of Neptune."



A tank readily gets enough energy creating oxygen for its fishes from the air



The water in a tank of fishes cannot easily get rid of excessive and deadly carbon dioxide

Punch gently poked fun at the fancy in its issue of December 13, 1856:

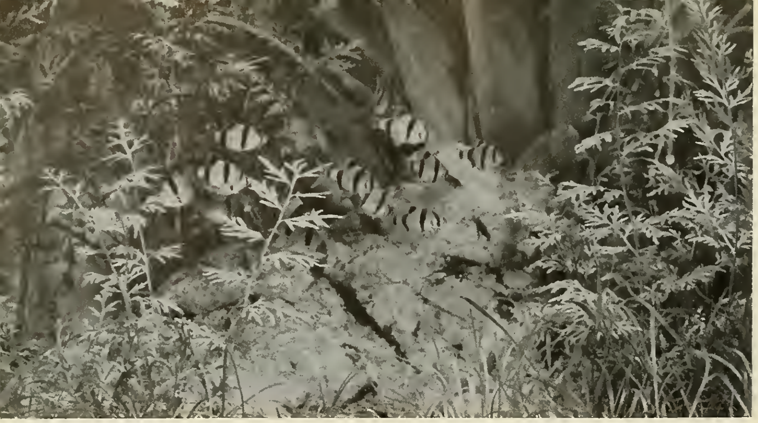
Oh, come with me,
And you shall see
My beautiful Aquarium;
Or if that word
You call absurd,
We'll say instead Vivarium.

'Tis a glass case,
In fluid space,
Where, over pebbles weedy,
Small fishes play:
Now do not say
You think they must be seedy . . .

My Dicky sings,
And claps his wings,
I know that what he wishes
Is to escape
His cage, and scrape
Acquaintance with the fishes.

Now tell me, do,
Suppose that you
Your mode of life could vary;
Which would you like?
To be my Pike?
Or to be my Canary?

By 1858, at least nine books on the keeping of home aquaria had been published in London, and an encyclopaedia of 1854 included an article on the subject. In all of these and in various newspaper and magazine articles, too, the idea of balance between the aquarium's plants and animals was stressed. Our myth was now firmly fixed in common knowledge; a host of amateur aquarists practiced its precepts



New York Zoological Society photo by Sam Dunton

▲ A NATURAL SETTING for jewel-like Sumatra barbs is provided by *Sagittaria* (*foreground*), water sprite (*right and left*), and a sword plant (*rear*)

daily, and they and their friends saw living proof of it each time they looked into a tank.

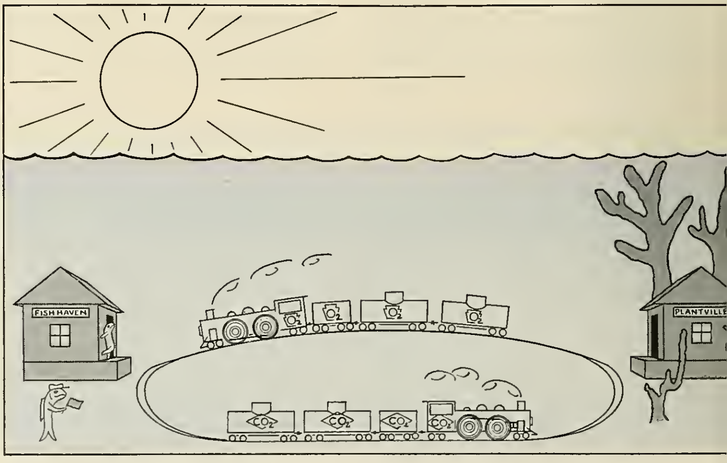
There was living disproof of it to be seen also, but this was either overlooked or reasoned away. For many years previous, fishes had been successfully maintained in bowls and tanks without any plant life in their water. How did that fit into the scheme? In 1856, Shirley Hibberd expressed the view taken by aquarists on this matter: "*The Philosophy of the Aquarium* must be clearly understood . . . It is a self-supporting, self-renovating collection, in which the various influences of animal and vegetable life balance each other and maintain within the vessel a correspondence of action which preserves the whole. A mere globe of fish is not an aquarium in the sense here indicated; because to preserve the fish for any length of time, the water must be frequently changed. . . ."

And yet hundreds of aquarists before and since have kept fish in tanks without plants and without changing the water for months on end. Hibberd himself kept a tank of goldfish with no plants and without changing the water for seven years. He explained this by attributing the oxygenation of the water to microscopic and algal growths. He wrote that, although it may take some time for a tank "to become richly clothed with suitable oxygen makers, some supply of oxygen is secured from the very first, for I have seen ciliated spores and beginnings of genuine vegetable deposits within a few hours of the first furnishing of a tank. Hence it was that . . . I did not hesitate to introduce the fishes as soon as the tank was furnished, without waiting for the full development of the microscopic forest, for I knew that before the fishes exhausted the oxygen in the fresh river water, there would be the beginning of a new supply for them, and there was never any distress through that procedure." Since fish can live in a newly set up tank without any apparent plants at all—either introduced or grown *in situ*—there must be enough unseen ones present to oxygenate the water, else the fish would die! The reasoning was fallacious, but somehow the facts had to be made to fit the belief.

In addition, it has always been well known that at night or on dull days plants consume oxygen and give off carbon dioxide just as animals do. How did fish survive such periods in an aquarium? Was it by breathing oxygen that had been stored up in the water while the plants were producing it? No aquarist ever said so, but this was implied in some of their works. A little thought on the properties of oxygen dissolved in water would have shown this to be impossible.

Similar inconsistencies can be traced right down through the books and articles written today on the care of tropical fish. Only one popular writer on the subject has recognized this—C. W. Coates in his weekly column, "Tropical Fish and Home Aquaria," appearing in *The New York Sun* each Friday. I have seen an aquarist hotly maintain that plants are indispensable in an aquarium, while literally under his nose was a tankful of his own cichlid fish—notorious plant-rooters—living contentedly without a sprig of green. Some concepts are simply too good to discard, even if they are untrue; the balanced aquarium is one of them.

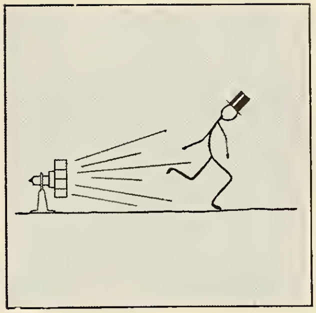
Proof that the balanced aquarium existed only in the minds of its devotees and an uncritical public



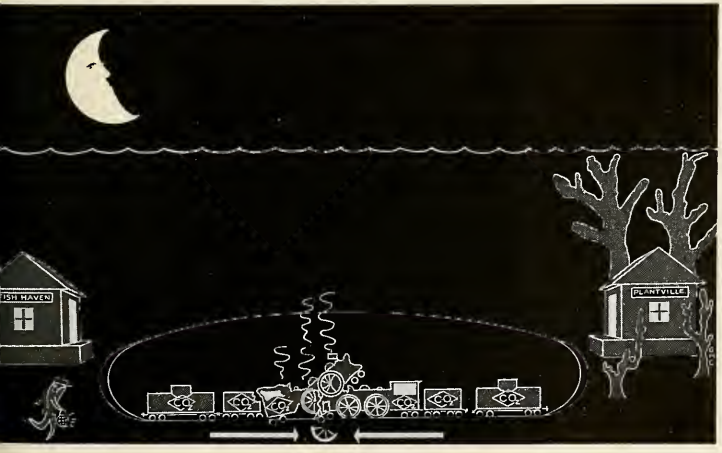
In daylight, plants help fishes in the same tank by using up carbon dioxide. The fishes also help the plants by providing carbon dioxide was published in *Copeia* in 1931 by Charles M. Breder, Jr., at that time Research Associate at the old New York Aquarium in Battery Park. His proof that "the production of oxygen by the photosynthesis of plants in open balanced aquaria contributes little, if any, to that consumed by the animal life therein" was obtained most directly—simply by *measuring* the amount of oxygen present under different conditions. No one had ever bothered to do this before, and Breder found that as far as oxygen was concerned, an "over or under saturation returns with extreme rapidity to equilibria" with the air above the water. In other words the water is practically never under or oversaturated with dissolved oxygen. As soon as the slightest deficiency in oxygen exists in a tank, oxygen from the atmosphere passes into solution to make it up. Similarly, if an excess is produced by plants under the influence of bright light, this quickly passes off into the air.

In fact, one might say: just try to keep oxygen out! Research workers in fish physiology sometimes want to determine exactly how much oxygen a fish consumes. To do this, they must measure the oxygen in a *sealed* container of water before and after a fish has lived in it. The problem is to get a seal that will keep out the atmospheric oxygen during the course of the experiment. Even one and one-half inches of heavy mineral oil, floated on the top of an aquarium's water, will not entirely keep out atmospheric oxygen from above, when the fish begin to use up the gas already dissolved in the water below. Scientists have had to design some complicated apparatus to circumvent this difficulty.

Despite this omnipresence of oxygen, every aquarist has at one time or another seen his fish gather at the surface of their tank, "gaping." What makes them come to the top, breathing rapidly, seeming to be in some sort of respiratory distress? Not a lack of oxygen but an excess of carbon dioxide. Compared with oxygen, this gas passes from the water into the air and from the atmosphere into solution much more sluggishly. Consequently, when an excess amount of it appears in an aquarium, it takes an appreciable length of time for it to pass off. On the other hand, Dr. Breder found that in tanks where plants were actively engaged in photosynthesis—building up carbohydrates out of water and carbon dioxide and giving off oxygen—the carbon dioxide remained far below its equilibrium level with the atmosphere for extended periods.



Aerating a tank or stirring the water does not ordinarily help the fish with oxygen, but it does hasten removal of poisonous carbon dioxide



At night, or in insufficient light, the plants actually restrict the fish population by adding to the carbon dioxide

Plants, then, can and do make an aquarium more habitable for aquatic animals by using up the carbon dioxide that the latter produce—carbon dioxide which, as Dr. Breder put it, is "the limiting factor as regards the respiratory gases." If plants were at work all the time, a tank containing them could support more animals than one without. But at night or on dark days, when they cannot carry on photosynthesis, plants breathe like animals, adding their share of suffocating carbon dioxide to the water. They breathe, of course, in bright light, too, but then their respiration is far outweighed by their photosynthetic activity, and they consume far more carbon dioxide than they produce. Without bright light, however, the presence of plants in a tank actually lessens the number of fish that tank will support. Contrary to general belief, putting plants into an aquarium does not make it possible to keep more fish in it.

It has long been known that carbon dioxide in excess kills fish or man. It has an exaggerated reaction on the blood of many fishes, called the Bohr Effect, after the physiologist, Christian Bohr. Relatively small amounts of carbon dioxide increase the efficiency with which the blood of some fishes can deliver oxygen to the tissues; but at the same time, it decreases the ability of the blood to take on oxygen at the gills. The fish thus uses up what it has and cannot replace it. This can be demonstrated by

Continued on page 96

THE POLYPHEMUS *Moth*

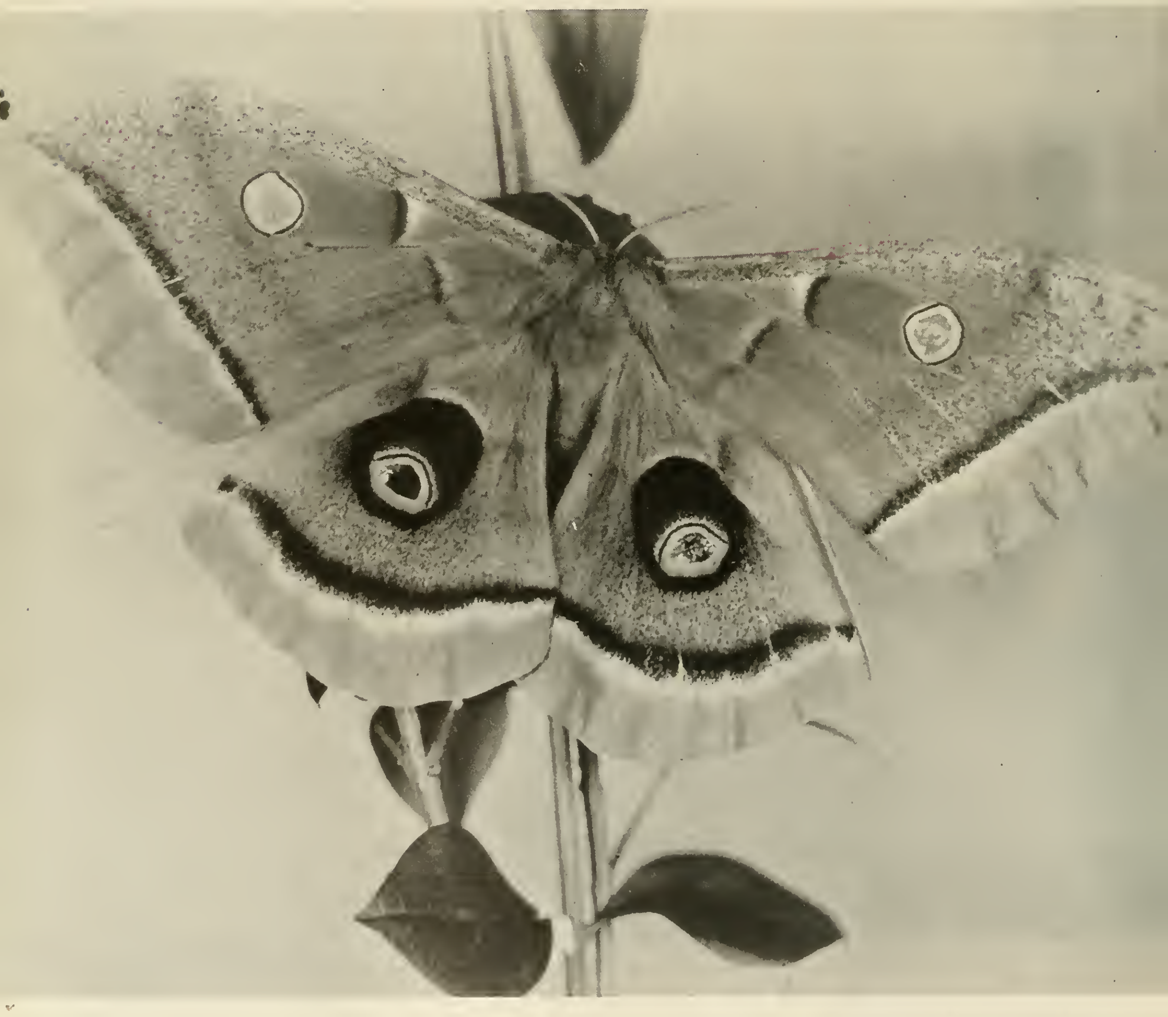
By ARTHUR C. PARSONS

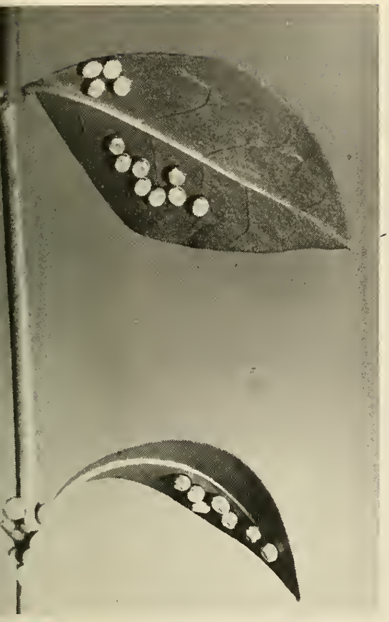
All photographs by the author

From egg to winged adult, this beautiful insect provides an interesting study in transformation that can be observed in all parts of the United States

LAST October a pale green caterpillar, three inches long and as thick as one's thumb, climbed down from the branches of the privet hedge bordering the terrace and crawled rapidly along the cement walk to the porch steps. There

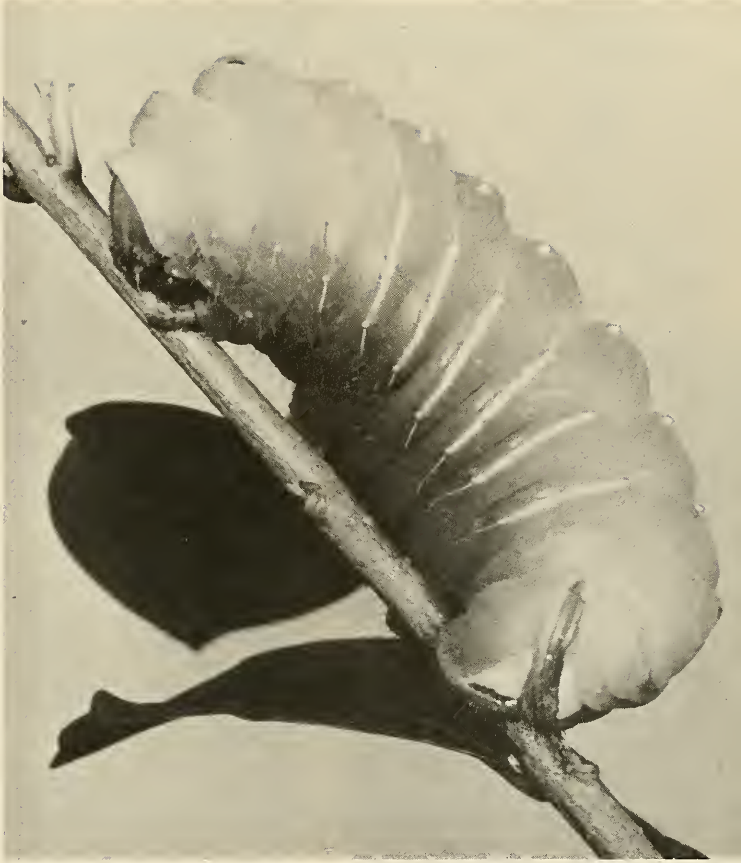
▼THIS FEMALE POLYPHEMUS emerged from the cocoon about one-half hour ago. She will not eat during the rest of her life but will lay 300 or more eggs





SHE LAYS THE EGGS on leaves upon which the caterpillars will feed. They hatch within ten days. Fewer than five per cent will probably survive to maturity

THE CATERPILLAR, pale green with red dots, molts several times during the summer and becomes about three inches long and as thick as one's thumb



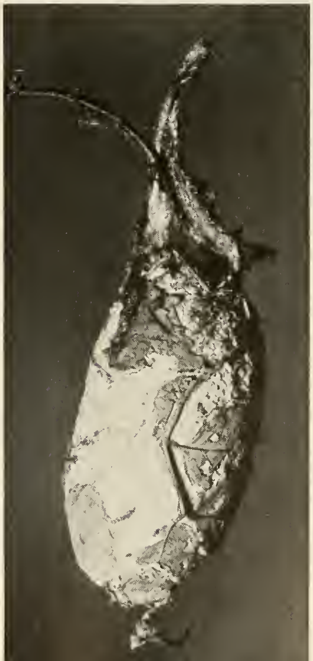
he paused for a moment, apparently trying to decide whether to mount the barrier or go around it.

While he was trying to make up his mind, I picked him up and put him in a box until I could get my camera and tripod. Then I placed him on a branch of the hedge, arranged a piece of gray cardboard behind him, and tried to take his picture; but he was not the most willing subject in the world. Like most insects, he insisted on moving out of focus every time I was almost ready to snap the shutter, but I did manage to make three exposures after a half hour of patient work. I wished to make some Kodachromes of him the following day, so I placed the caterpillar in a breeding cage supplied with twigs of privet, barberry, wild black cherry, and oak so that he would have his choice of food.

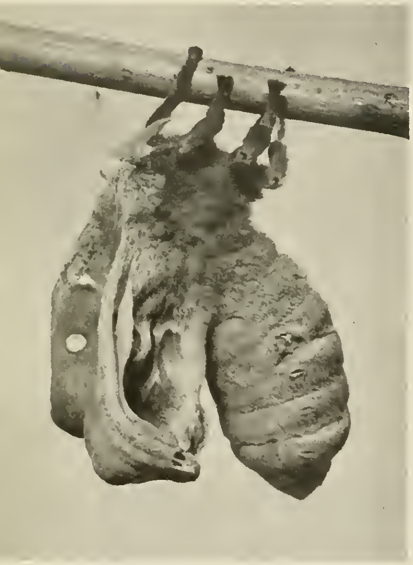
Apparently the caterpillar had eaten enough food during the preceding months, for when I returned from work the next afternoon, he was no longer there. Instead there was a compact, silken cocoon, two inches long and nearly an inch in diameter, lying in the leaves on the bottom of the cage.

The cage was put outdoors for the winter so that the moth would not emerge at the wrong time or lack sufficient moisture. Moths will emerge during the winter if the cocoons are kept inside, but care must be taken to moisten them regularly to prevent them from drying up. Polyphemus cocoons es-

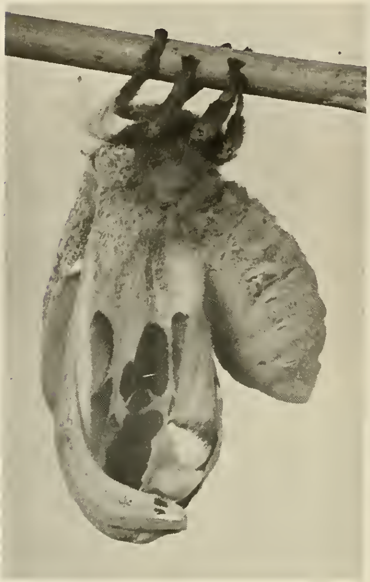
THE THREE-INCH CATERPILLAR spins a two-inch silken cocoon for itself. This one was on a barberry twig



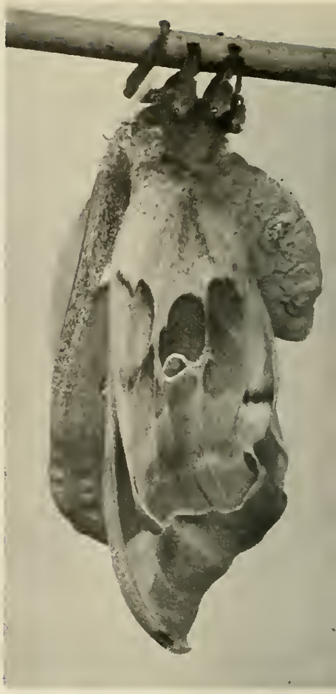
HALF A YEAR LATER, in May or June, the moth emerges. At first the wings are wrapped around the body and appear small in proportion to it



THE WINGS unfold and lengthen as fluids from the body are pumped into them. The body grows smaller as the wings enlarge



WHEN THEY have reached full length, the wings begin to widen. About 20 minutes are required for them to become fully expanded



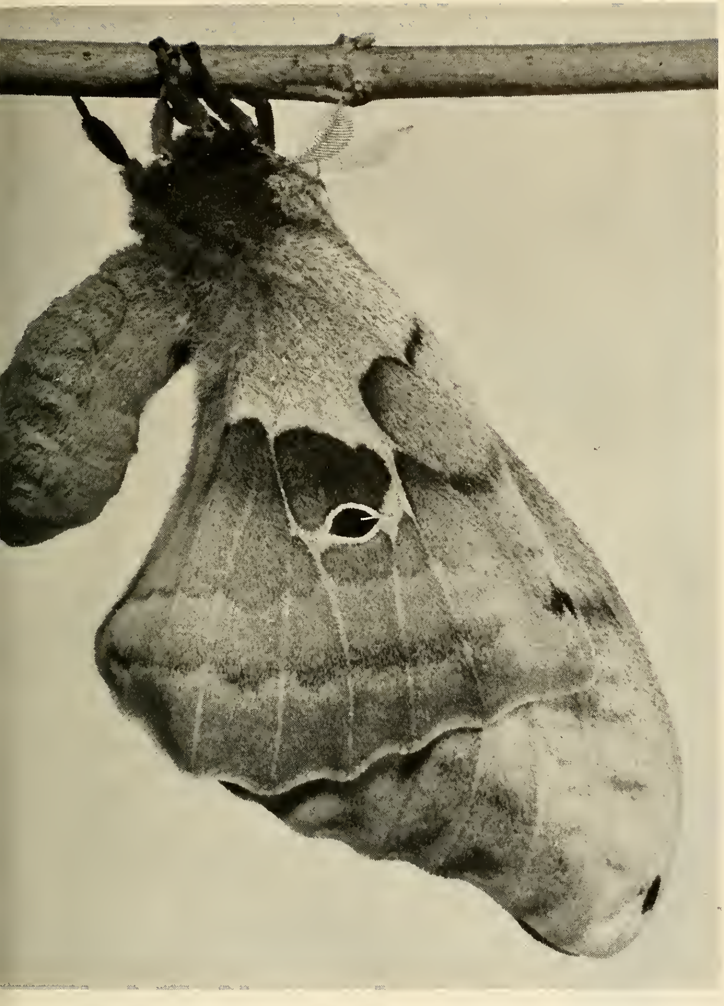
pecially need moisture to ensure perfect insects.

On the 15th of last June, a scratching sound could be heard issuing from the inside of the cocoon, a certain indication that the moth was preparing to emerge. A damp spot appeared at one end of the cocoon, for the moth emits a secretion that softens the silk threads, enabling it to escape more easily. Then a tiny hole appeared in the center of the spot. This grew larger so that the moth was able to get a pair of legs through, and then the insect pulled itself out quickly as if glad to be free after nearly ten months of imprisonment. The Polyphemus is especially obliging in letting you know in advance that it is ready to appear; others, such as the Cecropia and Promethea, come forth quickly and silently with no scratching sounds to warn you.

Any moth just emerging from the cocoon is a sorry spectacle. The Cecropia and Promethea have their wings wrapped around their bodies and bear little resemblance to the beautiful insects they will be an hour later, but I believe that the Polyphemus is the most bedraggled of all. The body is wet and huge, and the wings are stubs not much larger than a thumbnail. The antennae look natural, but they are so large that they make the poor moth seem even smaller. However, you will see a great change in a matter of minutes. The moth immediately climbs out on the nearest branch, in this case a privet twig. It hangs with body down and begins to vibrate both body and wings. The fluids in the body are pumped into the wings, which at once begin to lengthen and unfold, as can be seen in the illustrations. You can actually see the veins appear and watch the unfolding of the wings. As the latter become wider and longer the body decreases in size. At the end of twenty minutes the wings have attained full size, but the moth is not yet ready to fly. For an hour or more the insect slowly opens and closes its wings in order to dry and harden them. This particular specimen crawled out of the cocoon a few minutes past four in the afternoon but made no effort to fly until after six o'clock.

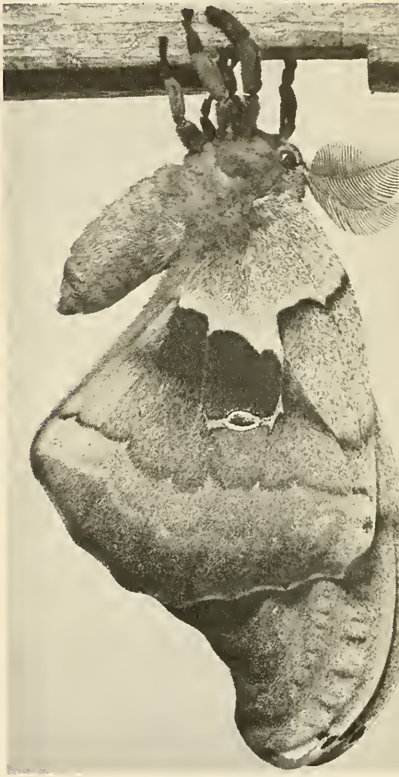
During the winter I had found another cocoon hanging in a neighbor's barberry hedge. I placed it in the cage with the other one, and the moths emerged one day apart. Fortunately one was a male and the other a female, so I was able to photograph both to show the difference in the size of the body and the antennae. The coloring is the same in both, but the male is not so large as the female and has a more slender body and much larger antennae. The latter are so large that they resemble small ferns.

The female deposited 326 eggs on the leaves and branches placed



◄IN ORDER to hasten drying, the moth slowly opens and closes her wings. A few minutes after this picture was taken, she made her first clumsy flight

▼COMPARE THE BROAD ANTENNAE of this male Polyphemus with those of the female. Both moths are beautiful creatures. Wherever a pair find each other, the yearly cycle of eggs, caterpillar, cocoon, and winged adult may be renewed



in the cage. They hatched in a few days, and the tiny caterpillars at once began feeding. The food plants are many—I have seen the caterpillars on oak, birch, maple, apple, barberry, and privet. Normally, very few of these caterpillars would survive to spin cocoons in the fall, for birds, animals, poisonous sprays, and ichneumon fly parasites exact a large toll. There are never enough of the caterpillars to do any serious damage to our shade or forest trees.

The Polyphemus moth gets its name from the large "eye" in each lower wing, because in classical mythology Polyphemus was one of the one-eyed Cyclops. These yellow, blue-ringed "eyes" with a brown pupil can be fearsome-looking objects to a predatory bird, for they resemble the fierce eyes of an owl when seen close up. Early one morning I saw a robin swoop down upon a Polyphemus that was resting on a post, but when the bird came within a few inches of his intended prey he suddenly put on the brakes and departed hurriedly. Evidently he did not like the appearance of the "eyes." Other birds are not so easily frightened, however, for I have seen many pairs of Polyphemus wings lying on the ground at a pump station in the woods. The moths had been attracted by the bright lights, had remained there until dawn overtook them, and the birds had descended upon them.

The caterpillar does all of the feeding, for the moth has no mouth parts and its life span is short. The Polyphemus lives only long enough to mate and deposit her eggs on suitable food plants. Then she dies, her mission accomplished. The caterpillar lives four months, the moth about that many days.

The Story of the Fish Anguilla

From the days of Aristotle almost down to our own time, people pondered over the mystery of how eels reproduce their kind, but the perplexing problem was finally solved

By WILLY LEY

THE two most important things about the fish *Anguilla*, the common eel of rivers and lakes, were put into writing some 300 years ago by the famous Izaak Walton, in his equally famous book *The Compleat Angler.*

"It is agreed by most men, that the Eel is a most dainty fish; the Romans have esteemed her the Helena of their feasts; and some the queen of palate pleasure. But most men differ about their breeding: some say they breed by generation, as other fish do; and others, that they breed, as some worms do, of mud."

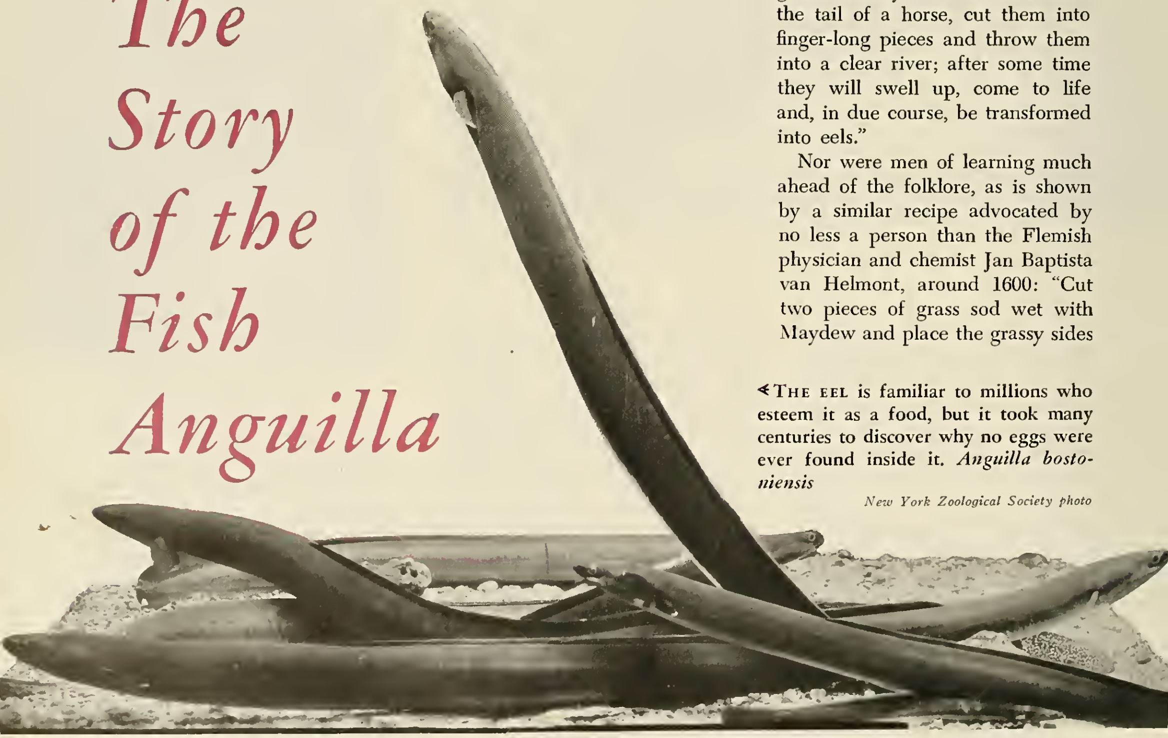
The first of these two sentences may astonish some American readers, since the eel, probably because of its serpentine shape, is not valued highly as a food fish on this side of the Atlantic. Europeans may have their differences, but they are in full agreement that the eel is superb as a food fish, provided it has been well prepared. But there are some differences concerning the meaning of "well prepared." In the northern European countries, especially along the seashore, smoked eel is preferred, while farther inland it is either boiled with dill or served cold in aspic. The fishermen along the shores of the Baltic go everybody else one better; they smoke the eel first and then fry it in butter. The fact that the eel is not a rare fish may have added to its popularity. Generally, where eels are found at all, they occur in rather large, sometimes incredible, numbers.

So much for Izaak Walton's first statement. As for the second—that is a long and complicated story, full of surprises.

Since the oldest times, fishermen have found roe or milt in their fish when the season was right. But in the case of the eel, there seemed to be no such season. Nobody could truthfully claim to have seen eel roe, and Aristotle, some 2000 years ago, summed up popular experience when he stated that "the eel has no sex, no eggs, no semen and originates from the entrails of the sea."

Since the problem of the eel's spawning was such a deep mystery and since the eel, on the other hand, was such a common fish, it is not surprising that various superstitions sprang up, taking deep root in the course of time. German folklore, recorded in the sixteenth century but probably centuries older, provided a simple recipe for increasing the supply of eels in a given locality: "Take hairs from the tail of a horse, cut them into finger-long pieces and throw them into a clear river; after some time they will swell up, come to life and, in due course, be transformed into eels."

Nor were men of learning much ahead of the folklore, as is shown by a similar recipe advocated by no less a person than the Flemish physician and chemist Jan Baptista van Helmont, around 1600: "Cut two pieces of grass sod wet with Maydew and place the grassy sides



◄THE EEL is familiar to millions who esteem it as a food, but it took many centuries to discover why no eggs were ever found inside it. *Anguilla bostoniensis*

New York Zoological Society photo

together, then put it into the rays of the Spring sun, and after a few hours you'll find that a large number of small eels have been generated."

Propagation being so simple, it posed a major puzzle. Why, for example, were the Rhine and all its tributaries swarming with eels while the Danube and its tributaries were devoid of them? Dr. Konrad Gesner of Zurich, the great Swiss zoologist, decided that the water of the Danube must be "inimical" to eels and stated that eels thrown into the Danube would soon die. This explanation was probably accepted by his contemporaries; and it is safe to say that they would have disbelieved the real explanation had anybody been able to tell it.

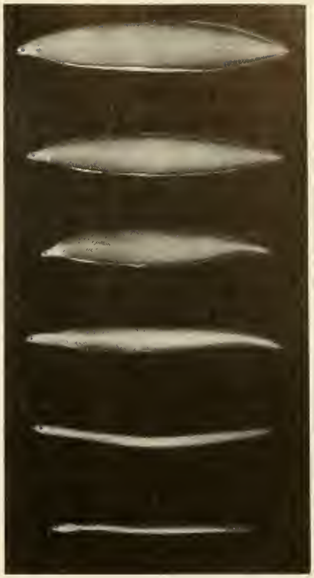
But in spite of these fanciful ideas—that young eels originated from Maydew in moist grass and that pieces of horsehair would come to life—the weight of practical experience tended to indicate that eels gave birth to live young. Every once in a while an eel "full of tiny eels looking like twine" was caught, apparently furnishing visual proof. Unfortunately, these tiny "eels" were neither eels, nor fish, nor even vertebrates. They were intestinal parasites—worms (mostly nematodes) which infest all kinds of fishes. If they were found inside a pike or carp, nobody was puzzled for a minute; but if found inside an eel, they were baby eels.

While fishermen and zoologists living inland remained hopelessly confused, their confreres living near the seashore had some additional, and apparently quite simple, evidence. Every autumn more or less fully grown eels were caught in increasing numbers along a stream, and it could be inferred that they were migrating to the sea. In spring swarms of small three-inch eels left the sea and gradually worked their way upstream. Because, they were transparent at first, these young eels were called "glass-eels" along the European continental coast. British fishermen referred to them as elvers. They soon lost their transparency and became practically black.

After notes were carefully compared, the question seemed nicely settled about 100 years ago. Some well-known fishes like salmon, shad, and sturgeon went upriver for spawning but otherwise were not really river fish. The eel reversed the process: it was a fresh-water fish but went to sea for spawning. That was true for *Anguilla anguilla*, the European eel, and also for *Anguilla chrysypa*, the American eel. And the Danube river system did not harbor eels because the Danube empties into the Black Sea, where eels probably could not breed. It was not the water of the river that was "inimical"; it was that of the sea beyond the mouth of that river.

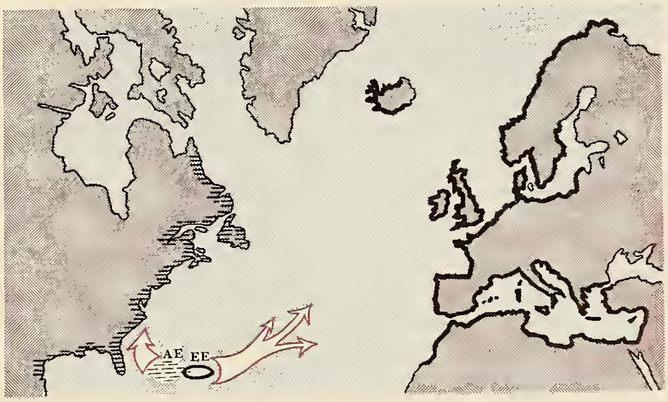
This is what natural history books, beginning about 1830, presented as the facts of the case. They still said the same thing in 1880. And still in 1900 and in 1905. But meanwhile a kind of quiet revolution had taken place, which went unnoticed for some time.

It had begun in 1856. During that year a naturalist, a certain Doctor Kaup, had caught a very curious little salt-water fish. It was interesting mainly because of its appearance. If you had some in a salt-water aquarium, you would think at first that the aquarium was empty. Looking more closely, you would see a few pairs of tiny, dark eyes apparently swimming around by themselves. Intent watching would disclose watery shades trailing the eyes. Out of water, the fish would look like a laurel leaf made of flexible glass, thin and fragile and transparent. You could place the fish on the page of a newspaper



After Johannes Schmidt

▲ **Six stages** in the transformation from *Leptocephalus brevirostris* (*at top*), found far out in the Atlantic, to the completely changed young eel found near the coast (*bottom*). (About ¾ actual size)



▲ **Breeding areas** of fresh-water eels in the Sargasso Sea in relation to their destinations in America and Europe. It is not clearly understood why one kind goes west, the other east. Under normal conditions they do not seem to intermingle or a book and read the type through its body without difficulty.

Doctor Kaup did the usual thing. He searched the literature for an earlier description of the fish and, finding none, described it himself. Following scientific custom, he also selected a name. It was *Leptocephalus brevirostris.*

And that was that for some time. Another fish had been discovered, nobody knew whether it was rare or common. But two Italian ichthyologists, Grassi and Calandruccio, had read Doctor Kaup's description and had decided they would investigate leptocephalus a little more, if and when they found the time. They later admitted that they would not have waited so long had they known what they were to discover. But they did not know, and there was always other, more pressing work. The investigation of leptocephalus was postponed from year to year. Meanwhile, they had at least learned that the fish was not rare; if needed, specimens could be obtained from Messina.

The long postponed investigation began in 1895. At first the procedure was routine. The fish were caught near Messina, and an aquarium to please the inhabitants of the local waters was prepared. Several leptocephali were put into it, and Grassi and Calandruccio began their work by trying to find out what leptocephalus would eat. Many an investigation of living animals has come to an end because of feeding problems. But there was no trouble on that score; these little fish ate most of the food that Grassi and Calandruccio expected them to eat. They ate and swam around and appeared to be in good health —from what you could see of them.

But they shrank! The largest of the leptocephali had been 75 millimeters (3 inches) long when caught. It lost a full 10 millimeters while under observation. It also shrank in the other direction, becoming narrower and losing its typical leaf shape. And then, with suddenness, leptocephalus became an elver, a "glass-eel"!

When they had recovered from their surprise, Grassi and Calandruccio announced that Doctor Kaup's genus *Leptocephalus* was not valid. Leptocephalus was merely a kind of larval stage of the eel. Upon passing through adolescence to maturity, the eel returned to the sea unless prevented from doing so. The mature eel, the scientists concluded, laid its eggs at the bottom of the sea and presumably died, since nobody ever saw large eels returning upriver. The eggs hatched into the larval stage (Doctor Kaup's mistaken *Leptocephalus*) and stayed near the bottom until they were either changed or about to change into the elver stage. The elvers then swam to water of less and less salinity and finally entered the rivers.

Grassi and Calandruccio also had an explanation for the rarity of the leptocephalus stage. It was rare, they said, because the larvae stayed near the sea bottom. It was just a lucky break that specimens could be procured from the Strait of Messina, where currents often swept deep-water forms to the surface. Thus, modestly ascribing their own success to their advantageous position, the two Italian scientists concluded their report, which constituted one of the great contributions to science.

At long last the mystery of the eel's spawning and breeding had been solved.

Still, this was not the end of the story. The scene shifted once more, to another year, another sea, and another expert. The year was 1904; the sea, the North Atlantic between Iceland and the Faeroe Islands; the expert, the Danish biologist Dr. Johannes Schmidt, working for the Royal Ministry of Fisheries on board the small Danish steamer "Thor."

From the "Thor" Dr. Johannes Schmidt caught, *by means of a surface net,* one of the transparent laurel leaves that the two Italian scientists had made so famous. Beyond doubt it was *Leptocephalus brevirostris,* and it was as long as the longest specimens from Messina, namely three inches. Doctor Schmidt was mildly elated. A leptocephalus had come to the surface for some unknown but probably interesting reason.

A few months later another one was caught, this time off the Irish coast and again at the surface. Now it began to look as if Grassi and Calandruccio had not spoken the final word in the story of the eel. Either their findings applied to Mediterranean eel larvae only, or they had unknowingly generalized somewhere, taking a reasonable assumption as a proven fact and arriving at a misleading conclusion.

Tooth of a

HOW SMALL IS THE SMALLEST?

ON previous fossil hunting expeditions we had been interested in *big* prehistoric animals—dinosaurs—so it is all the more remarkable that Mrs. Hunter should have found this little tooth.

In 1937, we were thirteen miles north of Eastend, Saskatchewan, in an area known as Cypress Hills. The bare exposures at the head of a little river called Calf Creek had been quite productive. In all, we were able to find some 2000 separate fossils at this location. But in many ways this smallest specimen is the most interesting, not only because of its size and its ancient story but because of the adventures it went through after its discovery.

We had been digging in the exposed slopes of a low hill whose rocks had been laid down in the Oligocene. Mrs. Hunter was almost ready to go back to camp for the day, when I heard her call out. From her actions you might have supposed that she was trying to take a splinter out of her hand. When I saw what she had, I could scarcely believe my eyes. It was incredible that anyone could have eyes so sharp as to see this tiny tooth amid the jumble of rocks and dirt.*

ncient Field Mouse

The tiny object behind the magnifying glass is a molar from an animal that lived 22 to 35 million years ago. You may well ask how it was ever discovered

By Fenley Hunter

AMNH photos

▲ **Scarcely bigger than a pinhead**, the molar can hardly be examined without the aid of magnification

▲ **Under the lens**, it can easily be recognized as a tooth. The animal to which it belonged was never found, but from the configuration of its cusps, the tooth can be identified as the second molar of one of the oldest known field mice

We carefully wrapped the tooth and put it into a matchbox. Back in Garden City some weeks later, some of our scientific friends were at the house, and we brought the tooth out. The celebrated paleontologist Dr. Walter Granger, veteran of many fossil hunting expeditions, was among the guests, and we felt he might find the tooth interesting. We handed it to him on a crumpled piece of tissue paper, and he walked to the light to examine it.

"There is nothing here except cigarette ashes!" he said. We all looked and saw that he was right. The tooth was gone. Dr. Granger felt terrible, of course, that the tooth had apparently disappeared while in his possession. A long search on hands and knees followed, but in the nap of the carpet we could not find anything so small. We searched for hours. Mrs. Hunter kept saying that the tooth had not been difficult to find in the first place and that it ought not to be now. However that may be, the tooth was still gone when the evening ended.

Mrs. Hunter began the search again bright and early the next morning, and at length she rediscovered the tooth in the upholstery of the divan. Of course, Dr. Granger was greatly relieved when we telephoned him.

So this little tooth is not only one of the littlest fossils ever found but perhaps the only one that had to be found twice. Dr. George Gaylord Simpson, of the American Museum, says it is a second molar and that it probably came from the jaw of one of the oldest known field mice (*Eumys*). In the Oligocene (22 to 35 million years ago), when this little animal lived, field mice were making their debut into history.

The tooth is now safe under a glass globe. Sometimes I look at it on the mantelpiece before going to bed, because I like to dream about what the world must have been like when that little creature was munching seeds of Oligocene vegetation.

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*For further illustration of Mrs. Hunter's eyesight, the reader is reminded that it was she who noticed the Franklinia blooms in an Audubon painting dated some 40 years after the Franklinia was supposed to have become extinct in the wild. (Natural History Magazine, October, 1947, page 337.)

Doctor Schmidt reported to the Danish Government and was given the assignment to discover more about eels, elvers, and leptocephali.

Having supplied himself with all available information, he sailed on the "Thor" and told the captain how the job might be tackled. The specimens caught by him so far had been three inches long—the size at which they should be ready to begin the change into elvers, assuming that the Atlantic variety behaved like that of the Mediterranean. Obviously the larvae had to be smaller before they grew to a length of three inches. Where would the smaller ones be? Grassi and Calandruccio had implied, and even stated, that with leptocephalus it was a case of "the deeper, the smaller." Doctor Schmidt's own experience had already shown that this was not necessarily the case off the coast of Ireland. How about the assumption "the farther out, the smaller?"

A nautical chart of Western Europe shows a line where the depth of the sea is 3000 feet; sailors refer to it as the 500-fathom line. West of this line is the deep Atlantic; east of it the shallow sea, which is a flooded section of the continental land mass. Schmidt found that the

Continued on page 95

WE SHADOWED
The Horned Toad

The toad that is not a toad and can squirt blood from its eyes makes an exciting fellow passenger on a transcontinental tour

By LORUS J. *and* MARGERY J. MILNE

Department of Zoology, University of New Hampshire

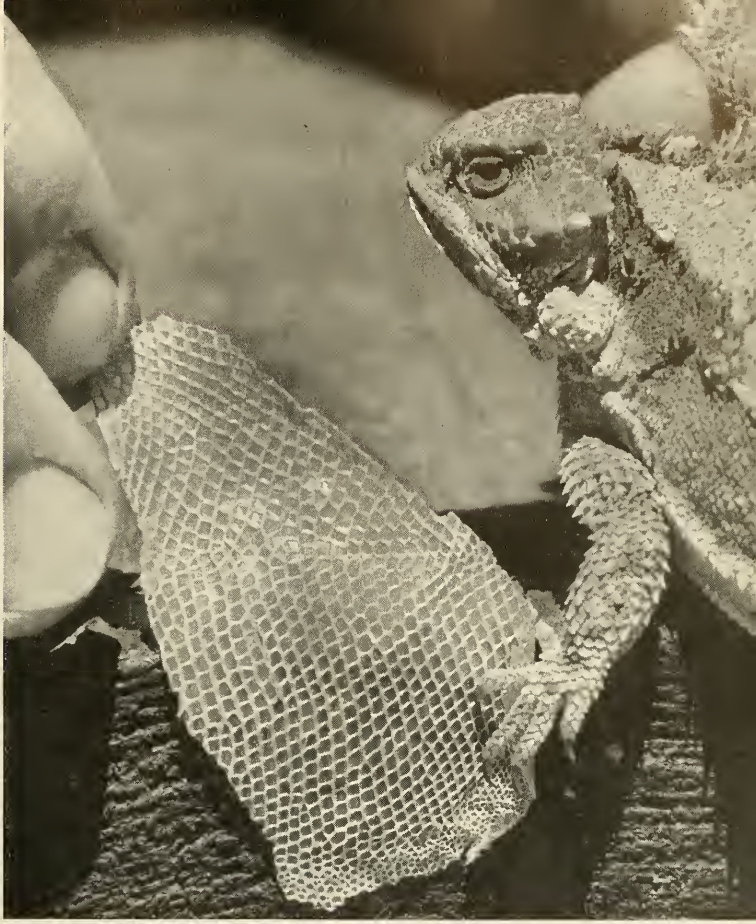
All photographs by the authors

NATIVE to our American Southwest is one of the strangest lizards in the world—the "horned toad." It was in central Texas that we had our first opportunity to watch this unusual creature, and to develop a fondness for it such as most people feel for robins, lady bugs, and chipmunks. Although able to scamper over the ground at the speed of a mouse, the horned toad seldom resists capture. Some horned toads, when taken into the hand, puff themselves up with air so that their sides extend in a smooth curve from forelegs to hind, and their belly surfaces bulge outward like a pneumatic pillow. Others deflate themselves to an altogether astonishing extent; and exploring fingers fail to find much, if any, indication of internal organs between the rough-scaled back of the creature and its very concave abdomen. Usually they keep their little black eyes wide open, yet try as you may, you can see no pupil—the cornea and iris are too dark. Occasionally a horned toad is less trusting, especially if you touch its back or horns; it may clamp shut not only its eyes but also its nostrils. The latter close like hot-air registers, with internal, scaly "dampers" that exclude the outside world.

On the dry ground, horned toads scurry from place to place in short dashes, interspersed with long periods of standing still, head and shoulders as far above the ground as the forelegs can hold them, eyes alert for movement of any insect near by. Their vision is keen and binocular, but they seldom attempt to chase down their prey as do many other lizards. Instead, they wait until the insect is nearer, or creep up to it slowly.

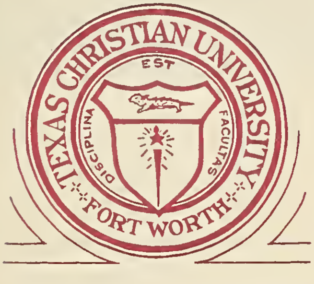
You will find much amusement in watching horned toads that have recognized some prospective victim. The first sign of awareness reminds one of a cat watching a mouse or a bird. The lizard's spiny tail curls jerkily from side to side with excitement. When the prey is almost within reach, the little reptile takes a quick step forward, and faster than the eye can follow, a pink tongue is extended. In a lizard, this similarity to a true toad or frog is remarkable. Neatly the tongue flicks the bug into the horned toad's throat. Commonly the food is ants, but other insects are taken whenever possible. Some-

◄WITH SHARP HORNS and spines, curved claws and strong legs, the horned toad seems well armored. Yet the inside of its digestive tract is apparently the only part of it that can stand the bites of ants. Its spiny exterior is too sensitive times large grasshoppers allow themselves to be caught. Several quick swallows are required after the first sudden bite, and the lizard throws its head and shoulders into a perfect frenzy of motion to keep the prey from getting crosswise in its ample, V-shaped mouth. The horned toad backs up, jerking its head from side to side and pressing it against the ground. In a few seconds the grasshopper's legs and wing tips are the only visible parts, and the lizard's ludicrous attitude might easily be interpreted as indicating surprise at its own success.



▲ **Horned toads** shed their skins periodically. Ridding the lips and eyes of the old skin is a complicated business that requires a special mechanism. Muscular cuffs around the jugular veins stop the return of blood from the head and cause the lips and eyes to bulge outward, so that the old skin tears away and falls free. The same circulatory mechanism sometimes causes the horned toad to squirt jets of blood from its eyes

A request for photographs started us on our most recent hunt for horned toads. We were planning a trip west, and the suggested project gave us a good excuse to take the southern route through Texas. We knew from previous experience that although these lizards are common throughout much of the Lone Star State, the natives know them as "little ol' horn frogs." The reptile is just one of the three "frogs" there—a vagary of language that puzzles a naturalist on a first trip. "Toad frogs" are toads—warty and phlegmatic. "Green frogs" are the wildly jumping sort that the easterner expects. Both of these Texas creatures lose their tails when they leave the tadpole stage. But the "horn frog" is the lizard of the three, an animal that wears its spiny tail for life and never has a swimming stage. It is far more completely adapted to existence in the arid Southwest than true toads or frogs and has a strange but obvious claim to man's friendly understanding. It is queer that we have no better name for these harmless reptiles (of which there are about a dozen species) without employing the scientists' term *Phrynosoma.* And a graduate of Texas Christian University at Fort Worth would be rightly indignant if asked about the *Phrynosoma* on his alma mater's coat-of-arms! So would a member of the institution's football team, which is roused to exert itself by tunes from the "horn frog band."

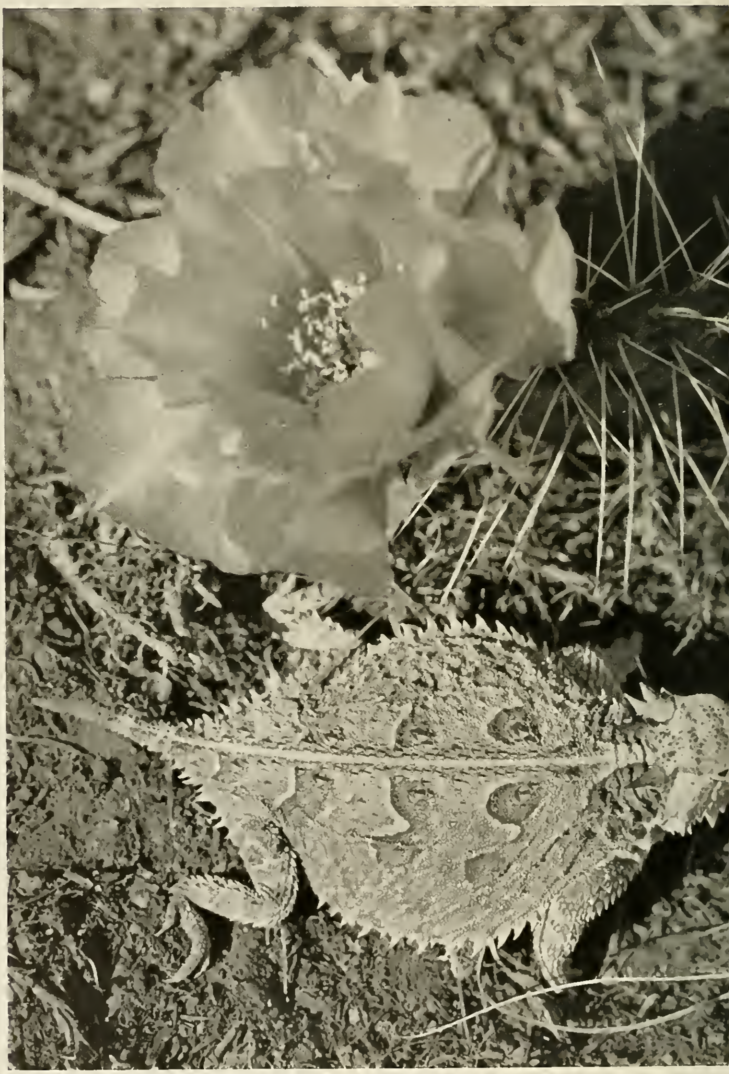


Less than five miles into Texas from the Oklahoma border, we spotted a horned toad at the edge of the pavement. We were overjoyed to recognize our old friend while we were traveling 60 miles an hour, and when we stopped and tickled its chest, it blew itself into a firm, flat, rough little balloon. But we wanted a photograph showing the lizard along a flower-studded roadside, engaged in some natural occupation such as feeding. Horned toads, we knew, ate ants—preferably the large red Agricultural Ant, whose broad mounds disfigured the fields we had passed in Oklahoma. All through the drier parts of the West the horned toads are regarded as beneficial animals because of the numbers of these damaging insects they engulf. Yet try as we might, we could find no sign of an ant along the highway border. More horned toads but no insects in the hot, dry air or on the sun-baked ground. Upon what could the lizards be feeding? In the blazing light we settled down to watch one. The lizard soon forgot us. Along came a beetle, which vanished as it passed the toad. A robber fly lit on one of the flowers, then crept down the stalk on some strange errand. The horned toad got it, too. We took pictures from every angle, then carried the collection of placid reptiles along for further observation.

In the car, the sun poured in on the lizards. Soon they opened their mouths and began to pant! We moved them to a shadier spot, and they closed their mouths, relaxed, and went to sleep. Would that so simple a remedy could relieve our perspiring discomfort!

Across the Texas Panhandle and into New Mexico we played the part of Hawkshaw, sneaking up on every horned toad we could find, shadowing its every move, with cameras ready to record the details of its private life. Then suddenly we got a surprise. The horned toad in front of us was different from any we had seen before. Instead of the tan to golden color, this one was brown with ashy flecks like spattered shoe polish. Gone were the eight brown marks down the back, each edged with a still darker line. In their place was an orange-yellow band with four extensions on each side. And whereas the familiar horned toad in Texas always appears to have had its back scales stroked the wrong way, the upper surface of this one was comparatively smooth. In astonishment we picked up the new horned toad. Where were its horns? Instead of the two long, glossy, upward-directed spikes of the Texas toad, it had short, obtuse bumps of brown spotted with gray. The side horns were brief, too, yet this was obviously a horned toad. We compared its color scheme with the more eastern form. Yes, it blended far more perfectly with the gray desert sand and matched also the brownish rock near by. But when we placed the New Mexican form on a bright red block of petrified wood, the color combination was rich beyond expectation.

In Albuquerque, the Milne family (toads and selves) paid a visit to the University of New Mexico and there consulted the biology faculty and also a few reference books. The toads submitted both to fondling and to sensitive fingers while the professors tried to decide whether we had found males or females. Only horned toads seem to know the answer to this question, and the matter was left unsettled. But our interest in the lizards received an unexpected lift at this conference. We learned that similar horned toads in captivity at the University had given birth to living young. Not just one, or two, or ten —but a score or more! And the professors had been trying to tell by



▲ PRICKLY PEAR CACTUS and spiny horned toad are common on the same arid lands. The lizard has been called the "cactus of the animal kingdom." But on a hot day, when the plant must stand high temperatures, the horned toad seeks shade periodically or digs into the soil where the sun's energy cannot easily reach it touch whether our specimens contained little lumps that might be unborn toadlets. More than ever we became determined to keep the lizards with us on the trip, to feed them if possible, and to watch for those unfamiliar offspring. We had so many adults already that *all* of them could hardly be males.

Living with an assortment of horned toads gave us excellent opportunities to learn more about them. And as we gained skill in recognizing these camouflaged lizards against their various types of backgrounds, we came to see not only adults but partly grown individuals almost everywhere we went. We fed them all kinds of food and found just one generalization to be true. Horned toads are aware of potential prey only when the prey is in motion. Dr. Raymond Ditmars, in his *Reptile Book*, gave as his experience that "horned toads will not eat earthworms." Ours did. Three-inch night crawlers seemed to puzzle the lizards for some time. Recognizing the head end appeared to be the difficulty, since this is the part invariably seized. But once a decision was reached, the worm went down the toad's throat just as easily as any grasshopper. Nor was the reptile's expression any less ridiculous when only a squirming pink tip of worm projected from the front of its mouth!

The speed of the prey was not too important. Our horned toads also ate snails. Anything that moved along steadily and was not too formidable went the way of Agricultural Ants. A woolly bear caterpillar went unmolested (apparently too large) until we "shaved" it. These lizards commonly stand beside an ant trail and pick up each insect as it runs along in either direction. Yet if a few of the same ants find a horned toad while foraging, they investigate its back and take exploratory nips at the skin. The lizard closes eyes and nostrils, remaining perfectly still for a while. But there are limits to its tolerance, for the horned toad may suddenly scamper off, writhing as though in agony, brushing away one ant after another in its progress through the fallen leaves and litter. If ants still cling, the lizard burrows into the soil and scrapes its body clean. It is clear, then, that only the inside of the horned toad's digestive tract is sufficiently sturdy to stand the bites and stings of insects. The seemingly tough and scaly exterior is too sensitive!

The relationship between horned toads and ants is obvious to everyone in the Southwest. In Arizona we learned that the Navajo Indians recognize as minor deities both the Horned Toad *yei* and the Red Ant *yei*. Stylized drawings of these animals form part of the Navajos' traditional sand paintings. On the floors of the juniper-walled hogans, the medicine men illustrate in bright dusts the *yeis* they pray to for health, rain, and fat sheep. The horned toad is a friendly member of the Indians' desert brotherhood.

Our detective duties proceeded through Utah, Wyoming, Montana, into southwestern Canada, and then down the Pacific coast. We became familiar with additional kinds of horned toads and at the same time kept our living collection for comparison and continual study. One of the adults from northern Arizona shed its skin and changed abruptly from a dull, spotted grayish-brown to a gorgeous creature with golden-yellow and glossy purple-black markings on its back. We must admit to helping in the skin-casting procedure. No one who enjoys peeling sunburn could sit by idly while a lizard was scraping off huge flakes of cloudy "cellophane" embossed in an exact replica of the body scales!

As we reached Salt Lake City, the weather turned still warmer, and we decided that the toads might not be getting enough water in their food. We should give them a bath. In the wash basin they objected frantically to any contact with the liquid, and one of us was so unkind as to suggest that all of them must be young males. But we held them submerged except for nostrils and soon noticed that enough water had seeped between their clenched jaws to give them a taste of the unfamiliar stuff. They were moving their lips and tongues just as if they had finished a meal. We dunked them some more, and several toads proceeded to drink the warm water. Their throat movements were gratifying to see, and after the strange episode was over, these individuals were plainly heavier from the water inside them. We repeated this performance week after week. The lizards all drink now but not unless we hold their heads under. None take our offer willingly.

We are still puzzled to know whether the bath was responsible for the next bit of excitement. As we left Salt Lake City, roadside stands were full of beautiful apricots at astonishingly low prices. We bought some and were putting them away in the coolest part of the car when one of us said, "How are the horned toads getting along?" In the excitement of the discovery, the bag of fruit was spilled all over the floor. The lizards' carton contained eggs, eggs, and more eggs! Twenty-three of them. Which horned toad was responsible? Would there be any more? How should we keep them? Were they fertile? Might they hatch? When? To which the driver, thinking of the distance still to be covered on the trip, added, "Where?"

The parent was soon recognized by her distended body opening. She was the Texas horned toad that had been identified as the only certain male in the collection! The eggs were about 5/8 of an inch long and 3/8 of an inch in diameter. Each had a soft, leathery, pebbled shell, pale cream in color, which indented easily as though the egg were not quite full. The egg we opened contained an embryo about as far along as a hen's egg that has been incubated for three days. We put the rest aside and hoped they would hatch along the way.

As the summer progressed and the desert became hotter, we saw fewer horned toads at midday. Their activity seemed restricted more and more to the cooler hours of the morning or just before sunset. While our own preference was for the same time of day, it was hard to understand such behavior in creatures that obviously thrive best in the hottest parts of our con-

▲ In the presence of larger animals, the horned toad usually remains perfectly motionless. The kitten sniffed at the lizard and walked away, then returned and lay down to watch. The horned toad can scamper over the ground like a mouse, but it was poor game for the kitten

tinent. Earlier in the season we had seen them at high noon, basking on warm rocks. Now, as sand temperatures rose to 110 degrees Fahrenheit and over, they stayed under cover except for the times of slanting sunlight. True, they would scamper forth for a few minutes into the full heat of day to approach an insect, but back to some shade they would scurry. A short exposure to 110 degrees F. or over is fatal to them. Odd, then, that they should inhabit only a region where such heat is common, even to the bottom of Death Valley and other hot spots where summer records show a shaded thermometer spending hours at 120 degrees F., day after day.

One day we cornered a horned toad beside a big rock and a very photogenic cactus in full, rich, red bloom. Here was a color picture for sure. But before we could get the cameras into position, the lizard had shown us how to escape both enemies and heat. With its head as a shovel, it burrowed down into the coarse soil. First it made something like a trench; then, using the spiny fringe along the sides of its body, as well as all four legs, it sank itself under the sand until only the top of its head remained in sight. At this level the soil usually provides enough insulation for the lizard to stay cool and live, though even here the heat may penetrate, causing the creature to pop out of the sand and seek shade.

The answer to the riddle of the horned toad's distribution in relation to temperature seems to lie in the narrow range of temperatures at which its many body processes operate most efficiently—98 to 100 degrees F. A mere 80 or 85 degrees, which causes easterners to mop their brows and turn on the fan, hardly warms a horned toad enough to make it interested in food. Its digestive tract is still too sluggish to function well. Horned toads live in the deserts and plains from British Columbia's Okanagan Valley to the Isthmus of Tehuantepec, and from Kansas to the Pacific coast, where they can count on summer temperatures that allow them to thrive. (They have also been introduced into Florida and other southern states.) The temperature at which full activity is possible is dangerously close to fatal heat; yet the toads require it. Their survival depends upon *warmth* from the sun rather than *light*. An electric hot plate turned on low just below a cage containing a horned toad, or a vent of live steam in the animal room, seems to be equally effective in keeping these interesting lizards alive and in good health.

At the foot of the Athabasca Glacier between Banff and Jasper, Alberta, and in the high campground at Crater Lake in southern Oregon, we felt downright sorry for our captive lizards. But the horned toad can stand cold far better than heat.

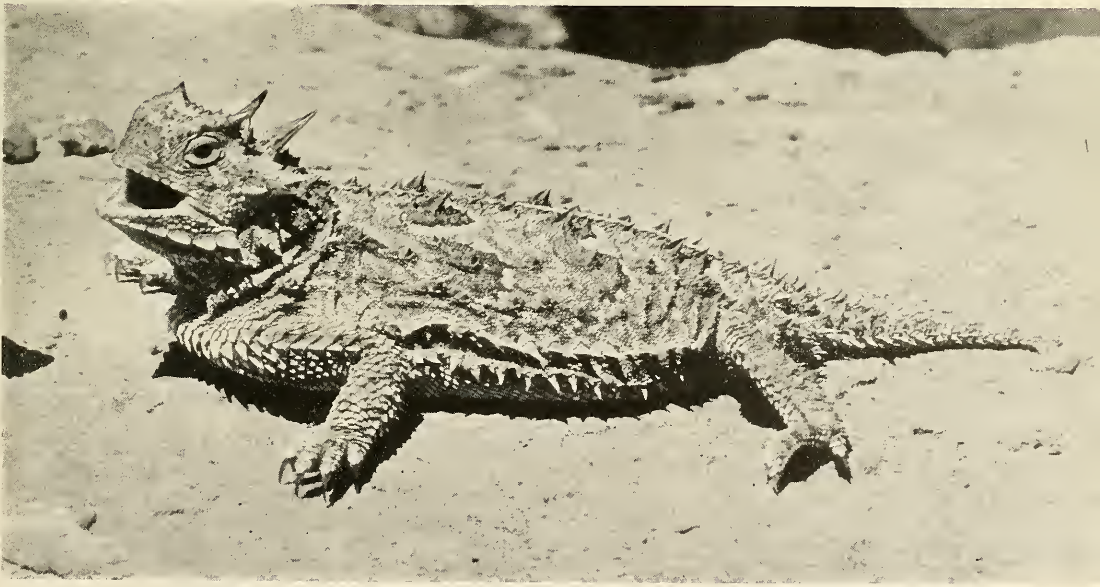
Under normal circumstances, it merely creeps into some sheltered spot for the night or during brief cold snaps. But when we began to shiver in our heaviest clothes, we did not forget our living collection. We took them into the tent with us at night, placed them between our sleeping bags, and covered them with a warm sweater. They quieted down and went to sleep, while dew stiffened to ice in the green canvas walls and roof. But the next day in the hot sun, they perked up and ate hungrily long before steaming coffee had induced us to shed our outer garments. Each year these lizards bury themselves for a winter hibernation; but even in summer at the elevations where many of them live, cold nights are no novelty to them.

Many bits of information accumulated as we observed the horned toads under natural conditions. Their protective coloration continued to intrigue us. Individuals of one widely distributed species would be pale and lightly marked on sandy or gravelly soil, while other members of the same kind among the litter of piñon or ponderosa pine would match the darker earth below. Their backs bore few tan or cream areas. Greenish yellow, rich browns like those in a freshly fallen pine cone, and various glossy grays or black were the colors most frequently encountered. And specimens from regions with lava outcroppings were different again. Even the color of the horns varied. In some they were brown, in others rusty red, black, or yellow. Each seemed to blend perfectly with the land on which it lived.

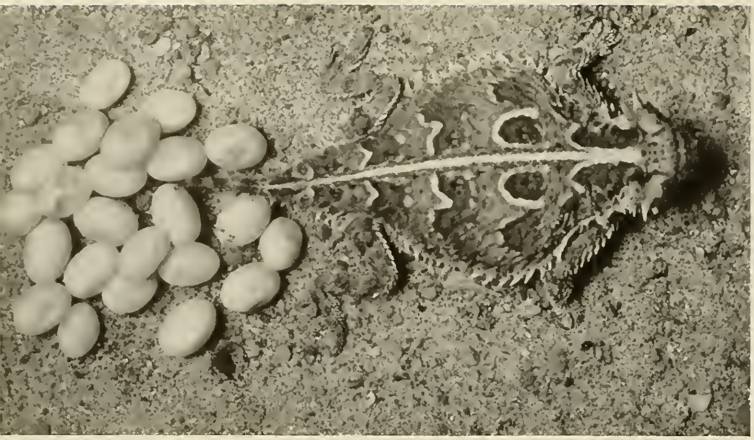
Camouflage as complete as this seems unnecessary for horned toads, for few animals show any interest in them. Except for a strip of the United States along the Mexican border where the road runner bird is common, the toad has no important enemies. Cats sniff at a horned toad and walk away disdainfully. Mature dogs do the same. So far, we have been able to get only a puppy to paw at a horned toad, and then the gnawing was less violent than would be expected on an old shoe. However, the reptile awoke from its feigned sleep and rushed away. The pup let it go, and we returned the lizard to its box.

There was a reason behind these experiments. We wanted desperately to see a horned toad exhibit its most weird protective measure. Under various kinds of provocation—from rubbing the top of the head to rougher investigation by a pup—horned toads have been observed to shoot a jet of blood from one or, on rare occasions, both eyes. Why this astonishing performance should terrify a potential enemy we cannot imagine, but the animal frightens its foes by sending the red droplets as far as six feet in an almost straight line.

This "hydraulic" defense system depends upon a mechanism common to many hard-headed reptiles. All the blood from their heads drains back into the general circulation through a highly muscular part of the jugular vein. Contraction of these muscles virtually stops the return of blood, and so the full pressure of the beating heart is transferred to the head. This causes a great swelling of the blood vessels

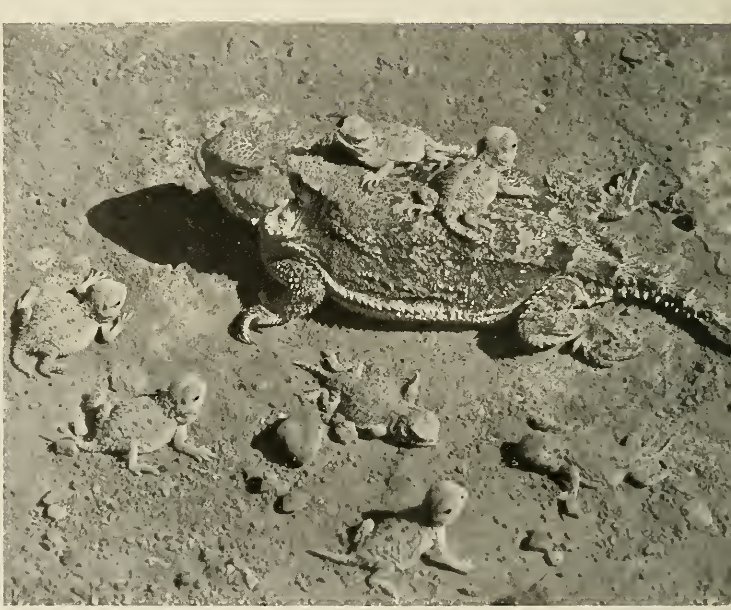


▲ When the sun beats down, the Texas horned toad may pant a while with mouth open before scurrying to a shadow or burrowing into the soil to escape the intolerable heat



◂ THE TEXAS HORNED TOAD, like a few other kinds in the Southwest, lays eggs with flexible, cream-colored shells. It buries the eggs and leaves them to hatch in the warm soil. Often the mother weighs less after her labors than the total weight of the eggs just laid!

▾ THE ARIZONA HORNED TOAD gives birth to active young, a dozen or two at a time, at about six-minute intervals. The young ones may climb on their parent if she chances to remain near them, but she shows no concern for them. Each feeds itself, making quick dashes to the side to capture tiny ants



there, so that the eyes, lips, and areas around the external ears bulge into new prominence. Ordinarily the "swell mechanism" operates only when the lizard is molting, and it serves to lift the old scaly skin free from the inflexible areas of skull between eyes and mouth. You will see it in action if you affix a small flake of court plaster or scotch tape to one of these lizard's eyelids. But when frightened, the blood may also spurt from the horned toad's eye. The jet emerges from either the third eyelid or from the corner of the conjunctiva near by. No other animal's eyes are known to become as "bloodshot" as this.

The significance of this strange ability is still far from clear. One observer has suggested that the reptile performs only when it is about to shed its skin, or has just done so and is in full brilliance. Our experiences do not bear this out. Surely our "helping" the lizard with the molting process ought to have irritated it sufficiently! Some day we hope to be lucky enough to see a horned toad in full action.

We were driving eastward through Nevada when we discovered that one of our northern Arizona lizards had become more pugnacious than usual. We segregated it in a new carton and decided to watch for developments. Unfortunately, other tasks prevented us from inspecting this lizard until the following day. Then we got a shock. For in the box there were *nine* lizards—the familiar but still pugnacious parent and *eight* babies! The young were very active, frolicking around and over their mother and occasionally getting stepped on as she moved about slowly, paying no attention to them whatever. Only when a youngster climbed up on her head and rested a foot on her eyelid did she react. Then she reached forward with a hind foot, calmly kicked the toadlet into a far corner of the box, and continued to scratch the place where it had been. Her babies made her itchy, nothing more! Mother love was as absent as in Don Marquis' famous cat, Mehitabel.

But the babies were the most ambitious, awkard, energetic, black-eyed little lumps of pinkish brown that one could imagine. Their rubbery bodies seemed too delicate to stand such rough treatment. Time after time they fell over on their backs and lay that way for minutes. They recognized tiny ants that we dropped in for them and rushed after them, frequently making a

▲ A NEWBORN HORNED TOAD of the Arizona kind has difficulty straddling a silver dollar and weighs about 1/27 of an ounce

catch. But anything larger was beyond their instinctive ken, and they scampered away from all manner of little bugs. Like the adults, the toadlets spent many hours of the day and most of the night sprawled out with eyes shut tightly in deep sleep.

This was the end of July. The eggs had been laid by the other kind nearly a month earlier. And one of us had watched the mating of adults one May in Texas. The male takes a cave-man grip on his mate, not holding her by the hair, of course, but clamping his jaws on one of her larger horns! These details seemed to lay out a time schedule for us that encompassed the more private features of the horned toad's life. True, we had not witnessed a birth, nor had we seen the Texas toad excavate a nest six or eight inches deep, pack it with eggs, and conceal them by filling the hole again. But we proceeded eastward with our enlarged family, believing that our education was growing by leaps and bounds.

In New England we were soon unpacking our belongings, while the horned toads were active in dry aquaria on a sunny window sill. They were busy, too, reducing the number of grasshoppers and flies we gathered for them. From time to time, one of us would sit down beside the caged lizards and watch them through the glass. The floors of the aquaria were littered with vegetable debris. Suddenly we recognized that something new had been added. There were one, two, three, four, five, very dead looking toadlets, each in an oblong glob of clear jelly to which particles of leaves and frass adhered. With a long pair of forceps, we reached into the aquarium and removed the babies to a glass finger bowl. We were bitterly disappointed that they had arrived when neither of us was watching and that all were dead. Then one wriggled. Perhaps they would live after all!

So intent were we on observing the babies in the finger bowl that we completely overlooked the possibility of more arriving in the main horned-toadery. When next we became aware of the parent or parents, two more babies were lying on the bottom. Which was the mother? Now all eyes were on the big aquarium, and we finally saw an eighth youngster drop. Carefully we put the Arizona female into a separate dish, where we could keep better notes on her behavior. While our backs had been turned to seek the mother, the original five babies burst from their transparent sacs. They were now bright-eyed and very active, scampering around in the finger bowl. We had a two-ringed circus on our hands, and each show was a distraction from the other!

The interval between births averaged slightly over six minutes. During most of this time the mother remained entirely quiet, but when each "labor" period approached, she would shrug her shoulders and curl her spiny black tail upward. Soon the youngster would appear, enclosed in a clear, colorless fluid, in a delicate transparent membrane. After it was free, the parent would take a few steps forward. Her exertions each time totaled less than a minute, from onset of visible movements to complete separation of the youngster.

With so many toads and toadlets on our hands, we could do no better than keep account of them by number. Offspring TEN was born at 11:53 A.M. in a very full sac of liquid. Its tail was curled up against it belly, its legs folded neatly at the sides. But otherwise its back was straight—quite unlike the usual compact embryo. The whole seemed perfectly cylindrical, in contrast to the broad, flat adult. Eyes and nostrils were closed. The undersurfaces were grayish white, and the back markings showed only faintly in the pinkish-yellow ground color. A short umbilical cord clung to the abdomen.

Fourteen minutes after birth, this youngster had burst its sac at the head end and extended itself enough to get its nostrils into air. Irregular breathing movements began and continued while the clear fluid drained from the sac. Soon the lizardlet wriggled, and gradually the collapsing membrane shifted farther and farther back toward the now extended tail. At nineteen minutes of age, the sac came free from hind legs and tail, and as though this were a signal, the youngster opened its little black eyes and ran actively forth. Its movements were so clumsy that it turned a somersault and landed on its back. But almost at once it righted itself and scampered off again.

By 12:55 it was dry and had taken on an ashy-gray color above. The toadlet was ready to fend for itself. It began catching insects a sixteenth of an inch long. Already it was nodding its head at its brothers and sisters, like an adult horned toad brought from solitary confinement into the presence of others of its kind. When the bowl containing the little lizard was rotated slowly, the creature exhibited compensating movements. There was no question but that it could see well and was fully equipped for an active life.

Fifteen youngsters were born in this late August litter. Six more arrived a week later—a sort of parental postscript. The fluid from their transparent sacs gave the finger bowls containing them a distinct odor like the white of an egg. We measured and weighed the babies. From nose to tail tip they averaged slightly over an inch, but a youngster looked comically small when placed on a coin. Each weighed approximately 1/27 of an ounce. The 4½-inch mother weighed ⅔ of an ounce after all her efforts —considerably less than the combined total for her progeny. She had not done quite so well as her Texas cage-mate, who had laid 23 eggs averaging 1/27 of an ounce each. And the rangy Texan was a lighter animal, so that her efforts represented well over her own weight in offspring. In fact, these horned toads need take a back seat to few members of the animal kingdom. Any creature that can lay eggs or give birth to young exceeding its own weight is really worthy of some publicity.

With so many horned toads on our hands after collecting only a few adults, we rather look down on Ellis Parker Butler and his "Pigs Is Pigs" story. When it comes to compound interest, no hay-eating guinea pig can compare with the horned toads we brought home.

Natural History

CRYPTOMAZE

BIRDS *By* EDWARD DEMBITZ

Part I. In this test you are given a set of definitions, each with a set of blank spaces, and a diagram to be filled in. Each definition is a clue to a word whose letters you are to insert in the blank spaces preceding the definition. These words appear in recent issues of NATURAL HISTORY Magazine.

24 8 15 17 5 8 25	*California mountain, site of world's largest precision instrument*
3 17 14 2 1 11 16 21	*Insect secretion—the "national dish" of certain ants*
6 17 4 10 8 18 14 22 18 23 23 16 8	*Ornamental tropical American vine whose leaf extract is considered a panacea by many Indian tribes*
7 17 17 19	*Mud hen . . . blue Peter . . . sea crow . . . splatterer . . . water chicken . . . pulldoo*
9 18 14 13 20 1	*Professor of Zoology at Indiana University, co-author of recent report on sexual behavior in human males*
10 2 17 11 4 7 9	*West Coast burrowing food clam: world's largest, weighing up to 12 lbs. each*
3 17 25 14 6 18 15 23	*Large tropical bird whose male feeds his imprisoned mate through a slit in a tree trunk during incubation*
24 23 8 14 19 8 18 14	*Common weed, indicator of soil ill-suited to growth of grass or clover*
17 1 13 19 20 12	*Mollusk which provides man with most nearly balanced diet of any single non-liquid food item*
10 4 18 14 16 8 21 17 12 5	*Long, threadlike parasitic nematode: thought to be the Biblical "fiery serpent" which attacked the Israelites (2 words)*

Part II. When you have filled in all the letters above, transfer them to the proper numbers in the boxes in the diagram below.

When the diagram is completed you will have a word maze which contains the common names of at least TWENTY-TWO BIRDS OF THE WESTERN HEMISPHERE. To find one of these birds, begin with a letter and move from space to adjoining space in any direction, including diagonally, until the name is spelled out.

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

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By Edward Dembitz

THREE PRIZES. *The three contestants submitting the largest number of Western Hemisphere birds fitting this puzzle will each receive an autographed copy of the* Audubon Bird Guide—Eastern Land Birds, *by Richard H. Pough, containing over 400 colored illustrations by Don Eckleberry, an outstanding book recently published by Doubleday and Company.*

The names in bold-faced type in the main A-Z section of Webster's New International Dictionary*—1948 (unabridged) will be used to determine the eligibility of birds. Names in bold-faced type below the line at the bottom of the page will also be counted, as will different names for the same bird. Genus and species names (in italics) will not be counted.*

In case of ties, duplicate prizes will be awarded.

Entries must be postmarked on or before February 20, 1949.

Winners and their scores will be published in NATURAL HISTORY *Magazine for April, 1949.*

The contest is open to everyone except employees of the American Museum and Doubleday and Company.

Continued from page 85

500-fathom line marked approximately the area of three-inch leptocephali. He also found that they were still about that distance from land, when, late in summer, they began to undergo the change that Grassi and Calandruccio had observed and described in such detail. By the following spring, they had become elvers and had also reached the mouths of the European rivers.

Unfortunately, the "Thor" was a small ship. It could not cruise for long beyond the 500-fathom line. Doctor Schmidt returned home, and then he received a report from the S.S. "Michael Sars," a Norwegian survey ship, that a much smaller leptocephalus had been caught far out in the Atlantic. Not having a ship comparable to the S.S. "Michael Sars," Doctor Schmidt did the next best thing. He contacted all the captains of Danish vessels sailing the Atlantic and asked for assistance in the search. He "held classes" for the old salts, telling them what to look for. He promised to furnish special nets. And he begged them, for the sake of science and the Danish fisheries, to make stops in mid-ocean to see what they could catch.

Twenty-three captains promised to co-operate. Among them, they made 550 stops to and from America to fish for eel larvae. Among them, they caught 120, a very small figure indeed but a significant result when the successful stops were located on a chart. It showed that the eel larvae seemed to have definite travel routes, that they did not just swarm all over the Atlantic.

By 1913, Doctor Schmidt had a good idea where and when to look, and he sailed on the small schooner "Margarete" on an oceanographic expedition devoted almost exclusively to one fish. The number of leptocephali increased and their individual size decreased toward the southwest. In that direction, undoubtedly, lay the true spawning ground. The "Margarete" ran aground in the West Indies after only a half year of service; but Doctor Schmidt knew by then that the spawning grounds were in, or rather under, the Sargasso Sea. Further research was interrupted by World War I, even though Doctor Schmidt's country was neutral.

In 1920, he returned to work, on the four-masted, engine-powered schooner "Dana." By then he and everybody interested knew that Grassi and Calandruccio had made one mistake. The leptocephali they had caught off Messina had not hatched in the Mediterranean but in the Atlantic, like all other European eels. *And* like all American eels. Meanwhile, American ichthyologists had shown that the American eel also left the rivers for the Atlantic Ocean, that it also started out as a larval form which changed into an elver. In the larval stage the American eel looks like the European eel, and both are hard to see. There was just one way to tell them apart, a way which required endless, tedious, and difficult counting aboard the "Dana."

Leptocephalus is made up of many segments. These number between 106 and 109 for *Anguilla chrysypa*, the American form, and between 113 and 117 for the European form. Occasionally the American variety had a few less, as little as 104, and the European a few more, as many at 119. They met at 111, and five specimens with that critical number of segments were caught. Nobody can say whether these five, if left alone, would have ended up in the Rhine or in the Hudson. The other 7000 specimens clearly belonged to one group or the other. Imagine counting the segments in 7000 specimens, most of them only an inch long and all, of course, transparent!

When Doctor Schmidt had neatly entered all his facts on large charts, one could see what happened. When the European eels left their rivers in the autumn (Schmidt, of course, was mostly interested in the European variety, for good commercial reasons), they seemed to travel with steady, high speed, arriving in the Sargasso Sea around Christmas and the New Year. Where they laid their eggs was not quite certain, but it was *not* among the drifting weed at the surface. It did not seem to be at the bottom of the sea either, since the ocean is quite deep under the Sargasso Sea. In any event, the smallest larvae, only about 7 millimeters, or ¼ inch long, were caught at about 1000 feet. During the first summer they grow to a full inch, or 25 millimeters; during the second summer they double that length; and during the third they reach 75 millimeters. Then, after the change, they swim upstream. Thus their travels consume 3 years, at the rate of about 1000 miles a year, and they evidently "ride" the Gulf Stream for much of their journey.

The American eels, which seem

Winners of the River Cryptomaze in the December issue of NATURAL HISTORY: The three contestants submitting the highest number of rivers listed in the Gazetteer of Webster's New International Dictionary (1948), in accordance with the rules of the contest, are: HAROLD EATON, Jackson Heights, N. Y.—54 rivers; W. D. STANTON, Cohocton, N. Y.—54 rivers; CAROL L. KRUEGER, Chevy Chase, Md.—53 rivers. Each of these winners has received a copy of *The Earth's Grandest Rivers*, by Ferdinand C. Lane, published by Doubleday & Company.

Rivers both above and below the line at the bottom of the page in the Gazetteer were counted, but variant spellings of the same name were not. Neither were more than one river of the same name. (It was not implied in the rules that, in spelling a name, the contestant could jump up and down on the same square to form a double letter. Where this occurred, the contestant was not disqualified, but he was not given credit for the river.)

Several contestants, by using sources other than Webster, produced lists considerably longer than the winners. They were not disqualified for doing this but were graded only on the rivers that satisfied the requirements of the rules, and on these they did not excel the winners cited above. Honorable mention, however, should be given to: William H. Loery, Staten Island, N. Y.; M. Douglas McIlroy, Ithaca, N. Y.; and D. H. Fry, South Pasadena, Calif. Other contestants too numerous to mention also made creditable scores.

to hatch in separate camps under the Sargasso Sea, travel at the same rate, but since they are only about 1000 miles from home, their growth is adjusted to the shorter time at their disposal. They are as large and as advanced when they reach their rivers as are the European eels.

The discoveries of Grassi and Calandruccio enabled both the Italian and the French fishery commissions to do what had once been tried with cut-up horsehairs and grass sods: to restock water depleted of eels. The French, especially, kept careful record of their work. They reported that each ton of elvers seeded into swamps and small waters off the river Aisne resulted in 2500 tons of food in 5 years.

Pliny may have been right when he gave "eight years" as the average time that eels need to reach maturity; the females seem to require from eight to twelve years and the males from five to eight. Then they go on a complete fast; aquarium specimens went foodless for six months until they died, which is reason for believing that the eel spawns only once and dies soon afterward. But some individuals do not mature sexually; these have been found to live more than 20 years and to reach a length of 6 to 8 feet and a weight of 30 pounds.

It may also be added that the Conger Eel, which stays in salt water, goes through the same transformation as the common eel, as does a variety of other eels and fishes. Its larva is *Leptocephalus morrisii.*

And finally, neither the water of the Danube nor the surface water of the Black Sea is "inimical" to eels. Perhaps the eels just can't make that long a trip before they are ready to be "river eels."

THE MYTH OF THE BALANCED AQUARIUM

Continued from page 77

placing fish in sealed vessels of water containing various concentrations of carbon dioxide. After the fish have been asphyxiated, appreciable amounts of oxygen will still be found in the water, and the greater the initial concentration of carbon dioxide, the greater will be the amount of oxygen remaining after the fish's death.

From this experiment, it is quite apparent that carbon dioxide actually prevents the fish from utilizing all the oxygen present. This is what its effect in an aquarium must be. In other words, fish can be starved for oxygen with plenty of it all around them, because they cannot take it into their bodies in the presence of relatively excessive amounts of carbon dioxide in the water.

Fish are suffocated in an aquarium by an excess of carbon dioxide, not a lack of oxygen, except under extraordinary conditions when a real oxygen deficiency may exist.

The reason the aquarist gets along so well, even while working under the wrong premise, is that he is doing the right thing—for the wrong reason. For example, when he aerates his tank's water or circulates it, he is not introducing more oxygen, as he usually believes, but facilitating the escape of carbon dioxide.

"A vessel of water containing plants and animals must be looked upon as a little world," wrote Edwin Lankester in 1856. We can now just as categorically state that it must *not* be so considered. Although the physiology of plants and animals in an aquarium is identical with the physiology of those in the world at large, the part they play in the ecology, or bionomics, of their tank is quite different from that taken by the sum total of all life in the earth's grand economy. In this sense, an aquarium is not at all a microcosm but merely a part of a macrocosm—part of a larger world from which it cannot be either physically or ideally separated. No balance could be expected to exist in such an open system. Looked at logically, the whole idea of a balanced aquarium seems baseless. But then, most myths never made a pretense of being logical.

BOOKS

Continued from page 55

outlet in natural science, education, mining engineering, exploration, collecting on a hitherto unprecedented scale, business management, and showmanship, but even up to the time of his death in 1906, he still yearned for other worlds to conquer.

As a scientist, his chief interest lay in fossils, though under the guiding spirit of Louis Agassiz his conceptions were greatly broadened and injected with a devotion to truth which even P. T. Barnum, the great showman from whom he learned many tricks, could not undermine. Nevertheless, despite his successes in founding museums and supplying them with exhibits (typically a plaster Megatherium skeleton surrounded by meteorites and fossil casts), he could never live down the suspicion, born of the esoterism of his day, that he was cheapening natural science through commercialization.

The book also throws some interesting high lights on the religious controversies arising from the advent of Lamarckism and Darwinism, which were particularly acute in the vicinity of Rochester, the birthplace of Mormonism and the Shaker communities. Thus Henry Ward, in addition to the economic problems of securing financial support for his enterprises, had first to awaken a scientific interest in many prejudiced minds.

In evaluating the character of Henry Ward, as portrayed by Roswell Ward, certain allowance must be made for a grandson's partiality. Yet, there is no evidence of "build up," but merely a straightforward narrative that speaks for itself. The presentation is simple, entertaining, and humorous in a quiet way, with all the documentary evidence relegated to the last pages. But, behind this simple result, lay the monumental task of collecting and collating the vast and scattered Americana that marked his grandfather's career. For this labor of love and devotion, Roswell Ward is to be highly commended.

It should be of special interest to all affiliated with the American Museum and the New York Zoological Society to learn that Frederic A. Lucas, William T. Hornaday, and Carl Akeley owe their rise to fame very largely to the influence of Henry Ward and his Natural Science Establishment.   George H. Childs.

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March

NATURAL HISTORY

1949

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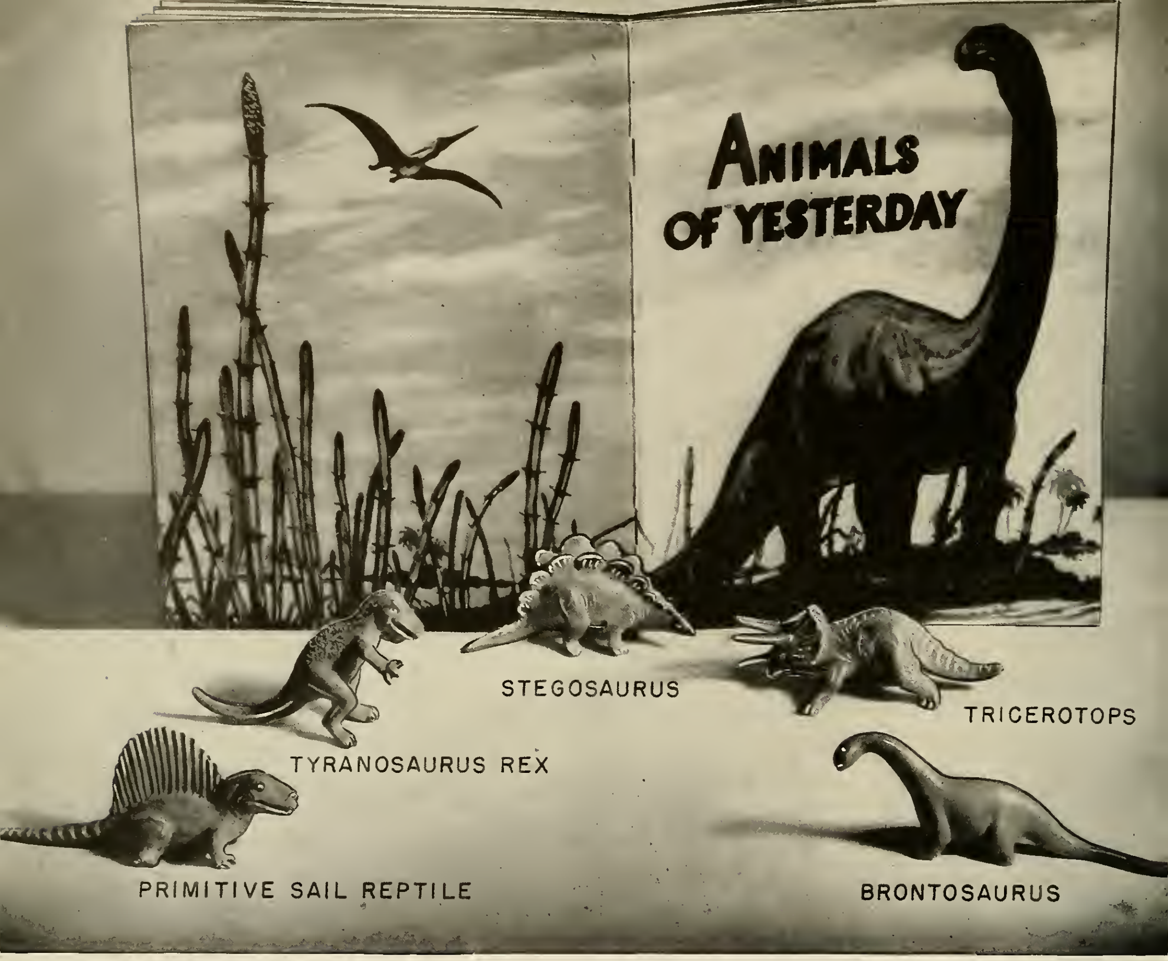
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Mass Invasion by Red-billed Queleas

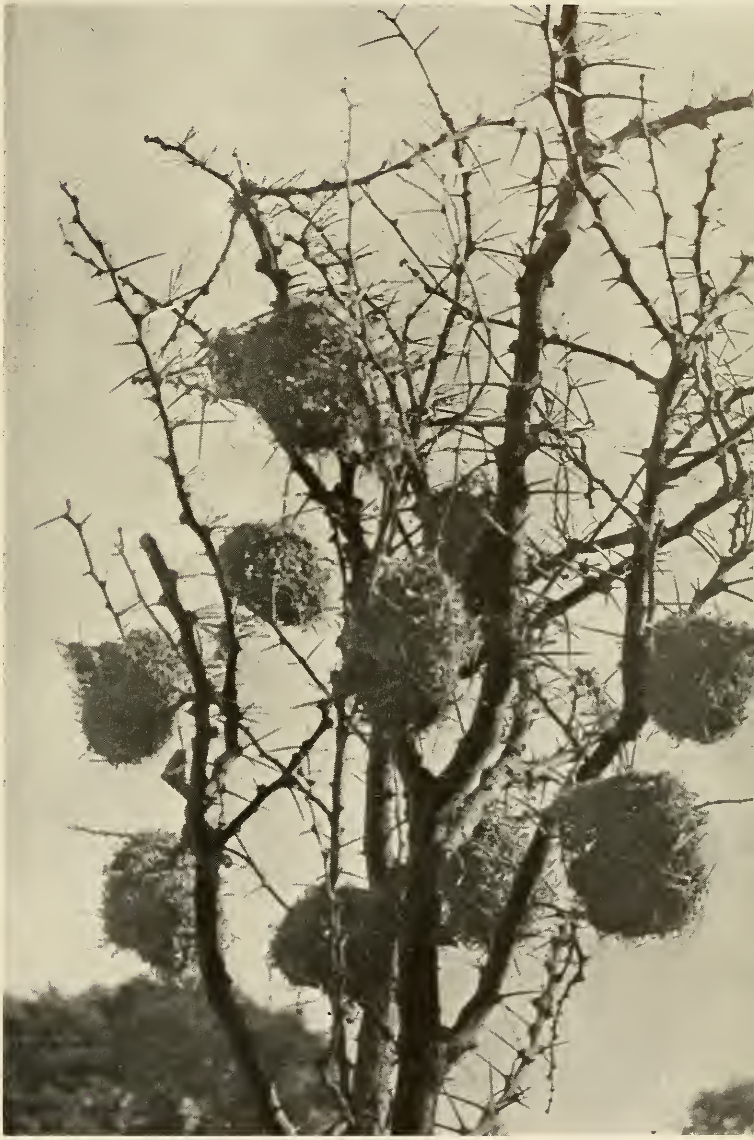
SIRS:

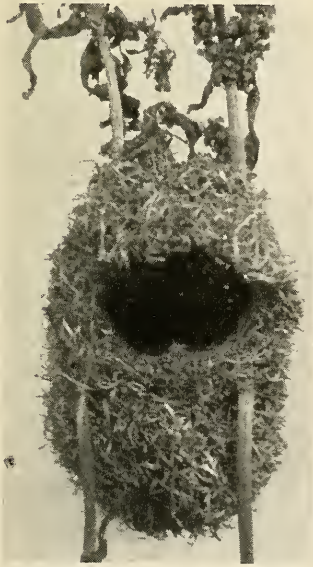
Every year during December and January the fields of kaffir corn (millet) in the western Transvaal are devastated by enormous swarms of red-billed queleas. As much as the farmer might loathe this gregarious finch, it offers to the student of natural history a fascinating subject for the study of flock behavior.

To investigate press reports on enormous damage done by these birds, I went with two other members of the Witwatersrand Bird Club to Bloemhof, on the Vaal River, to inspect the breeding colonies of the queleas.

Although small flocks were constantly encountered, we were told that the main colony had broken up three weeks before. What we found was a ghost city of birds. An area covering roughly 800 yards by 1 mile, thickly infested with thornbush and medium-size thorn trees (mainly acacia karroo and *Zyziphus mucronata*), looked from afar like an orchard heavily laden with oversized fruit. These were the nests of the queleas, and they averaged 50 per tree. One hundred adult birds per tree gave us a conservative estimate of two to five million birds for the colony.

Local inhabitants who had seen the colony at the peak of its activity said that the noise had been unbearable and that when the birds rose they covered the sun like a thundercloud. Now the place was utterly deserted and dead. With the queleas, all other life seemed to have departed. In the distance a laughing dove was cooing, and a few glossy starlings flew overhead. That was all.





Many of the nests, falling slowly to pieces, still contained eggs—sometimes whole clutches and not infrequently a dead fledgling, mummified, left to starve by the parents. What is this spirit of the swarm which calls the birds away and breaks their family ties? Where do the millions go? Are they lost in the wide, unexplored wastes of the Kalahari, emerging again next season to breed where the kaffir corn ripens?

During one month they do great damage, but what are they eating during the rest of the year? Some irate farmers are talking about flame throwers and poison gas, but can we foresee what would hap-

▲ DARK WATERS, a photo-study to kindle thoughts of warmer, sunnier days. By Fritz W. Neugass

pen if those millions of queleas were exterminated? How many tons of noxious weed seeds, how many millions of grubs, must find their way down their beaks!

Have you any suggestions how to minimize the damage without interfering with the laws of nature too much?

DR. W. GILGES, *Chairman,*
Witwatersrand Bird Club.
Johannesburg, South Africa

The following comments are offered by Dr. James P. Chapin, eminent authority on Africa in the American Museum's Bird Department:

The fabulous swarms of red-billed queleas in many of the drier regions of Africa have long been famous. One observer in the Blue Nile region wrote of "hundreds of millions"; another in southwest Africa reported migrating flocks that took three days to pass his farm and gathered meanwhile in vast numbers at a drinking trough for cattle.

Where these superabundant birds nested was long a mystery, and then about 30 years ago their great colonies in remote areas of the bush began to be discovered. Nests are often abandoned even before the eggs have been laid, but successful breeding must be frequent enough.

These are by no means the only members of the weaverbird family to raid ripening fields of kaffir corn, rice, and other cereals. Bishop birds and whydahs, in many regions, do the same. All across the Sudanese belt every year, the natives are obliged to mount guard as the grain ripens. Women and children patrol the fields to drive off the birds, the boys shooting little reeds from their bows; and other watchers build platforms in trees.

In rainier equatorial countries, prominent trees in the villages are occupied by considerable colonies of yellow and black weavers, which often fly down into gardens to peck at ripening ears of maize. The people even the score by gathering numbers of well-grown young from the nests and using them as food.

It will be well to study the age-old experience of natives before applying too drastic methods of control. During part of the year most finches destroy numbers of insects, and the seeds they devour are largely of no economic value. The right to protect crops cannot be questioned, even if a small proportion of the birds may lose their lives. Here in the United States, ducks, crows, and blackbirds are often found to be detrimental in grain fields; starlings and robins in fruit orchards. Yet careful research has shown that none of these birds should be decimated.

In Africa inanimate scarecrows are apt to be useless. People moving about the fields during the few weeks just before harvest time are far better. They may well wave flags on poles and make all the noise possible. Africans are splendid singers and drummers. Some mechanical source of high-pitched noise might supplement their efforts; and transcriptions of shrill African music delivered through loudspeakers would seem ideal. But that, of course, would cost far too much.

Turtles Basking on Ice

SIRS:

I am not out to "stump the experts"; neither am I an expert. But the *Union Sun and Journal* of Lockport, N. Y., recently published an item telling how, one day last month, several turtles were seen basking on the ice of Hopkins Creek. By the end of the day, 12 had been caught, among them a 20-pounder. Such an event is said by local residents to be unheard of.

I have come to appreciate your letters of explanation in NATURAL HISTORY and would like to know what you think of this—not only for my own benefit but for others around Lockport, including 13-year-old Richard Blackley, who wrote

NOTICE—Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on these pages will be paid for at $3.00 each, with full credit to the photographer. Return postage must be included.

NATURAL HISTORY

The Magazine of the American Museum of Natural History

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VOLUME LVIII—No. 3
MARCH, 1949

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You will find Natural History Magazine indexed in *Readers' Guide to Periodical Literature* in your library

THE COVER THIS MONTH

The American Turk's Cap Lily (*Lilium superbum*) is found over a wide range from Minnesota east to the Atlantic coast and from southern Canada to North Carolina.

The blooms are large, pendant, and recurved, varying in color from orange to orange-red, deeper toward the tip of the petals, and spotted with brown or crimson on the throat.

The height of the plant varies from five feet in the sun to nine or ten feet in shady places. Not particular as to soil, it thrives equally well under acid or alkaline conditions. It is contented on any ground that will grow good potatoes and will succeed in soil too soggy for them. Indeed, this color photograph by Arthur B. Close was taken in a marshy location.

The Turk's Cap Lily adapts itself to a variety of situations. It is decorative in a mixed border or may be naturalized in moist woodlands or meadows. The flowering season is July or early August, depending on latitude. Basal rot is unknown, but like most lilies, it is subject to the virus "lily mosaic," which mottles the leaves and, in severe cases, distorts the stem buds and flowers as well.

C. L. H.

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to me about it. Inquiries reveal nothing unusual in the conditions on that day except that the temperature above the ice was about 70°F.

Roy B. Kelley.

New Hartford, N. Y.

The following information is offered by Bessie Matalas Hecht of the American Museum's Department of Reptiles and Amphibians:

I find at least four authenticated records of snapping turtles being observed during the winter months in mud near melting ice and in water beneath the ice. In none of these cases, however, was more than one individual found at a time, which makes this newspaper account interesting. That several should have been seen basking on the ice, and that twelve should have been caught, may be explained by the unseasonably warm air temperature of 70°F. Only one air temperature is recorded for the other occurrences, and that was 33° F. below the present record.

Cold-blooded animals such as turtles derive their body heat from external sources. When the temperature drops, turtles hibernate in places where they will be protected from extreme cold. On mild days, as the heat from the sun warms the earth, the turtles have their body temperatures raised, and they become active, leaving their hibernating places even though it may be in the middle of winter.

The snapping turtle sometimes hibernates singly but more often in large aggregations and in a variety of places—under logs, in muskrat burrows, or in one or two feet of mud at the bottom of a stream. Because one of these hibernating "dens" may yield quite a few turtles, commercial collectors hunt them more often in the winter months, probing for them through holes in the ice. Catches of as much as 500 to 1000 pounds have been reported in a single day.

"Them that Has, Gets"

Sirs:

Congratulations on your new feature "The Cryptomaze." It seemed impossible that an already perfect magazine could be made still more perfect, and yet it would appear that that has been accomplished.

However, there is one little thing that has amused me greatly in January's word maze. The person who secures 23 wild mammals wins a copy of *Wild Animals of the World*. Well, I don't believe that anyone who succeeds in doing this needs a book like that! They either already own it or could easily compile a similar book! . . .

Mrs. Arthur E. Lamb.

Brooklyn, N. Y.

Mrs. Lamb may have something there.—Ed.

Too Small to Bother With

Sirs:

On a recent visit to Florida, I saw sharks, sting rays, giant morays, and other public enemies of the deep peacefully mingling with fishes that were smaller and less able to defend themselves, in the great aquariums at Marineland. Local attendants mentioned that adequate feeding prevents fish fights and that sharks and others attack only when hungry.

While lack of appetite might account for a shark's good behavior, it would hardly explain the little fish's lack of apprehension. It all surprised me very much. Surely a zoo could not mix such a variety of creatures. What is the explanation?

Joseph P. Crockett.

Washington, D. C.

The following answer is offered by James W. Atz, Assistant Curator at the New York Aquarium:

Adequate feeding will, of course, reduce the aggressive behavior of predatory fishes, and this probably partially accounts for the peaceful conditions at Marineland. There are, however, other factors. Predatory fishes do not necessarily prey upon *all* smaller fishes; in fact, they ignore those that are apparently too small to bother with. One of the tricks in keeping fishes of various species together is to have the difference in size so great that the larger ones will not concern themselves with the smaller ones. At the old New York Aquarium we were able to keep two species of killifishes with savage green morays.

It should be noted that the shark is not agile enough to catch many of the smaller fishes and that the sting ray feeds on invertebrates, such as crabs, worms, and shellfish, rather than on other fishes.

The fearlessness of the smaller fishes is easily explained. Fishes can adjust themselves very rapidly. They quickly "learn" that the large fishes in the tank will not try to eat them, and they soon lose any fear they may have had of them in the wild.

Cascades in Spring

SIRS:

Beautiful waterfalls along the sky line and spray-filled streams are to be seen in the Cascade Range in springtime when the warm sunshine melts the winter's heavy snow. Such scenes as the ones shown here can be viewed at many places on the highway across Stevens Pass in the state of Washington. They rival many famous ones.

Making the trip in the spring, the nature lover thrills to the sight of the "cup that runneth over." When he returns in midsummer, it is like driving a different highway, for not a single waterfall is seen along the mountain road.

MARGARET MEYER.

Seattle, Wash.

ELTING SNOWS, under a warm
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The traveler will find among the copious historical notes a bounty of necessary information in the form of tips as to the location of frozen foods, pre-Colombian goldwork and shrines, modern gown shops, salt mines, waterfalls, airports, ultramodern architecture, good hotels, bullfights, tropical agriculture stations, Indian tribes, and oil fields. Also included are tips on liberal and conservative newspapers, legal holidays (unfortunately not all are included), clothing, and equipment.

Packed into a "What's What" section is copious information on Colombian geography, climate, political subdivisions, population, government, language, religion, products, exports and imports, transportation to and within the nation, money, communications, etc.

Important facets of this work are the "Judsonmaps" of all large cities, as well as general maps and the 51 excellent photographs.

In short, the first of Harper and Brothers' "Judson Guides to Latin America" is a spanking good job. It makes one say: "Let's go to Colombia."

THOMAS E. GILLIARD.

CITY OF THE BEES

- - - - - - - by Frank S. Stuart

Whittlesey House, $3.00
243 pp.

ON the paper wrapper of this book the publisher makes the claim that in it "the marvels of a society older than man, and almost unknown to him, are revealed." If man in the sense of the general reader remains uninformed regarding the honeybee, it is certainly not the fault of the specialist. E. K. Phillips, for many years in charge of bee culture investigations in the United States Bureau of Entomology, has pointed out that hundreds, even thousands, of books have been written on bees and beekeeping and that "no other insect, and perhaps no other animal except man, has been so voluminously discussed." In view of the available accounts of established repute, one is inclined to look rather searchingly at any new claimant for admission to the order of merit and, where that claimant is found wanting, to be perhaps unduly harsh. This reviewer, at least, cannot help expressing his regret that the literature is encumbered through the addition of the present perfervid volume, which contains too much of a misleading character to be the preceptor of the uninformed.

The author describes the book as "an imaginative fantasy," yet he includes enough of the factual, even if embellished, to convince one that the work is not a contactless flight of fancy. The pages reek with anthropomorphism. An extreme case—but others as high-powered might be cited—is that of the "old soldier bee" who attracts the glances of the "nurse bees." We are told that the "soldier" is not to be blamed if it "cocks its whisker yet more fiercely, and rolls a languishing and magnificent black eye. Nursemaids and soldiers were ever thus." The reader need hardly be told that this imagery scarcely fits a creature that has an immobile compound eye, and that both the "soldiers" and the "nursemaids" are sterile females undifferentiated structurally. Such an alleged flirtation would indeed be empty and anemic!

HERBERT F. SCHWARZ.

NATURAL HISTORY BOOKS
Old, Rare and Out of Print
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JOHN JOHNSON
Box 248 Mt. Vernon, N. Y.

NATURE'S UNDISCOVERED KINGDOM

- - - - - by Walter J. C. Murray

George Allen and Unwin Ltd., London,
The Macmillan Co., New York, $2.00
98 pp., 19 photos

EVERY age has its poets and philosophers who "discover" nature's kingdom. Some draw word pictures; others paint and sketch. The author of this small book of nature studies has augmented his pen with the camera. The reader will enjoy the pictures but will remember the author for his lyric prose and sensitivity rather than for his photographic skill.

This work is "an attempt to understand the world of wildlife from a new angle." This "new angle" of understanding is the intimate contact with and response to nature on the part of an observer who is not merely content with knowing "the life history of every bird, beast and insect."

After this warning, the author takes us with him to mountaintops, to lush meadows, to overgrown copses, to blue tarns, and moist bogs. We watch with him the growth of a pet kestrel and we listen to the sounds of nature—the wind through tree branches, the shrill cries of hawks, the brisk chattering of squirrels. We see great flocks of birds darken the sky, moths gathering about lights in the evening. We tramp the countryside of the British Isles looking, listening, touching, tasting, and smelling. In addition to being a keen observer, our guide is a philosopher and a sensitive interpreter of nature. Indeed, the cool and calculating among us might say that he is rather emotional. He indicates the appeal nature makes to him when he writes: "Have you ever embraced a great tree in sheer wonder and delight at its towering strength and felt its rugged bark upon your cheek? Have you brushed with your lips the velvet of a newly opened flower in joy of its blossoming? Have you talked with birds? Have you at sunrise knelt with the heather on the mountaintops in adoration? These are a few of the notes in the great score." This is a book for anyone

Continued on page 142

Will conservation science be powerless before the sudden advance of agricultural and commercial development?

By Dan Lincoln Thrapp

AFRICA is a million years ago. Alone of the seven continents it presented to the earliest discoverers and to travelers even within living memory a spectacle of life on earth as grand as that of the Tertiary period. The oldest of continents, it also was the richest in animal life. Its ancient savannas and its forests teemed with myriad species of strange and beautiful creatures in a manner that had been common to almost all continents in late Pliocene and early Pleistocene times, before the ice advanced and before the Age of Man.

Only in Africa did this wealth of animals survive into historical times, and yet it seems likely that adults living today will see the remnants of the free wildlife of that continent disappear so completely that it will be judged by future generations only from specimens preserved in occasional parks, like our buffalo in the Yellowstone. If anything can be done to mitigate that sentence, it must be done promptly.

"Were one of the old hunters who operated 50 years ago to visit eastern Africa today he would find vast districts in which he used to shoot, completely denuded of game; in fact, it is probable that the game areas have been reduced by half and the game within many of those left by 75 per cent," wrote Capt. Keith Caldwell, wildlife expert, in a report on a survey which he undertook last season for a British organization. He listed as most important among the reasons for the reduction, the increase of native population caused by the end of famine and tribal wars, the

▼ Grant gazelle, one of the largest and best known African gazelles, as depicted in its natural homeland, in Akeley African Hall. In background at left: oryx

AMNH photo

SOS for African Wildlife

provision of medical aid in combating plague and other epidemics, and the development of civilization, with its growing craving for land.

But there are many other reasons for the disappearance of Africa's greatest asset. Most important among them are the calculated programs of game extermination to solve problems inherent in the conversion of that continent to civilization. Conquest of a frontier, in its earliest phases, means livestock production and agriculture, and game has had an adverse effect on both on the African frontier. Therefore, although the wildlife has lost ground steadily to the big game seekers, to native huntsmen, and to the advance of the settlements, the animals now face a program of scientific eradication with which they cannot cope. The reason for the slaughter is twofold: (1) grazing lands are needed for domestic animals and (2) the game harbors the tsetse fly, carrier of sleeping sickness in man, and a comparable disease, nagana, in livestock.

Enormous numbers of animals have been slaughtered in the past three decades. During the tsetse campaign in Southern Rhodesia between 1922 and 1945, some 320,000 head were slain and about 10,000 square miles of land cleared of wild animals. Figures for the past two years are not available, but in 1944 alone 27,000 head, mostly hoofed animals, were killed in that country. In 1945, official hunters killed 7518 duikers, 165 steinboks, 3177 Sharpe's steinboks, 912 klipspringers, and 187 oribis. All of these are small antelopes, and none of them had even been proved a blood pasture for the tsetse. During the first 20 years of the extermination program, 129,345 of these five species were killed.

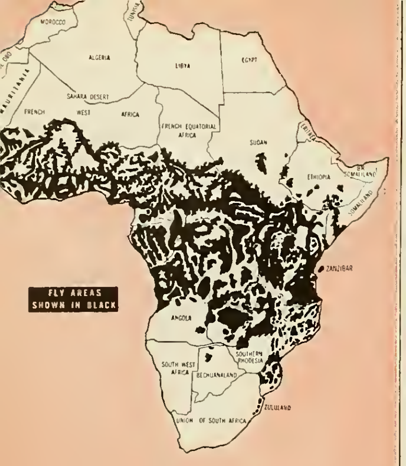
Caldwell calculated that some 30,000 native hunters in Tanganyika bag at least 180,000 head of game a year "by more or less legal methods, and this takes no account of game that is wounded and dies a lingering death, nor game killed by illegal methods, such as the popular poisoned arrow." He found that "opinion was unanimous that, with the exception of the buffalo and the elephant, game was disappearing rapidly." The native hunters use muzzle loaders, and although they rarely are expert shots, their kill is high, and the percentage of wounded game that gets away to die tragically in the bush is even higher, he wrote.

"One often heard it said, 'Oh, the native hunter always used to hunt game and he never exterminated it; why should he be stopped now?' " Caldwell wrote. "The answer is that in the past, hunting tribes always exterminated the game in their own areas but did not dare invade no-man's-land. Moreover, the native population was unstable; war and famine decimated the area—the land was left empty and the game flowed back. Pax Britannica changed all this."

Caldwell found an analagous situation in Northern Rhodesia, where fifteen years ago it was estimated that 80,000 head of game were killed annually by native firearms. At the turn of the century, Caldwell said, there were about 2,000,000 head of the beautiful lechwe in Northern Rhodesia. Today there are about 30,000.

Although the worst of the calculated butchery continues to be accomplished in Southern Rhodesia, the slaughter fever threatens to plague half the continent. The urge to kill off the game has spread, under one pretext or another, into the Union of South Africa and through Northern Rhodesia into Kenya, Tanganyika, Uganda, and even the Sudan.

The British government, and to a lesser extent the peoples of the Commonwealth, worked themselves to a high pitch of enthusiasm recently over peanuts or, as they are called in England, ground nuts or monkey nuts. After a prolonged investigation, the government approved a Rhodes-like plan, originally suggested by Frank Samuels, Managing Director of a commercial concern called the United Africa Company, for the highly mechanized production of peanuts in East Africa. The program called for the creation of 107 ranches of about 30,000 acres each in Tanganyika, Kenya, and Northern Rhodesia. The ranches would annually produce 600,000 tons of peanuts by 1950-51 and, eventually, 800,000 tons a year, a sizable contribution toward meeting the world's acute shortage of edible fats, which the British government feared would persist at least until 1960. The plan, which originally envisaged 80 ranches in Tanganyika, 17 in Northern Rhodesia, and 10 in Kenya, seemed a laudable one and met with general approval. It was estimated that it would cost about $100,000,000 but would pay for



MAP OF AFRICA SHOWING THE TSETSE FLY AREAS THROUGHOUT THE CONTINENT TOTALLING 4½ MILLION SQ MILES

MAP BY JOHN R. McDERMOTT

itself in a few years of capacity operation.

Results thus far have been discouraging. Only a small proportion of the land scheduled to be cleared has actually been combed with a plow, and only 7500 acres were planted last year. The estimated cost of the entire program has been revised upward 100 per cent, and the plan for 10 Kenya plantations will probably be dropped. Much of the equipment for the work was surplus war machinery which was found to be in a deplorable condition, and there have been few dollars to buy American tools for the job. The yield has been disappointing in many cases, even after the land was cleared and fertilizers applied. In one instance, on a different project, it was reported that thousands of acres of Masai land in Tanganyika were cleared for a wheat ranch. After some 2000 head or more of game had been shot, wheat was planted, but the yield was an infinitesimal half a bushel an acre. The game had been killed off, the land plowed and ruined, when the whole project had to be abandoned.

Nevertheless, the government is determined to go ahead with its ambitious schemes and will no doubt eventually make most of them successful. Partly because of the publicity given the peanut plan, restless Empire war veterans and civil servants displaced from India and Burma have turned land-hungry eyes on East Africa in recent years, and there has been a rousing boom in real estate, farms now bringing triple their 1938 prices. Lack of equipment, fencing, and other needs have hampered pioneers. Some of them have had to wait years for the barest essentials, and money and equipment have been lacking even to provide the colonies with adequate roads.

After E. E. Austen and Emil Hegh

⮝ THE TSETSE FLY that is the most common carrier of human African sleeping sickness—*Glossina palpalis*

But despite high prices, low productivity of much of the land, lack of materials, and the immense problems posed by the nature of Africa, the industrial age is coming to the sleepy eastern colonies, with all the roar and clatter of bulldozers and gang plows. On sketch maps of the vast territories, the proposed farms and ranches look no more important than fly specks on a wall, but their effect on wildlife will extend far beyond their own geographical limits. New railroads and ports will be built, new roads laid out. Villages will be needed to house the 32,100 Africans and 730 Europeans who will be needed for the peanut farms alone, and that will mean stores, hotels, and subsidiary settlements.

The military is not the least prominent feature of the flood of European civilization welling into the once-dark continent. The transfer of the great British Middle Eastern military headquarters from the Egypt-Suez area to Nairobi, and continued exploitation of the immense uranium wealth of the Congo, with the consequent speedy development of that once forbidding colony, would indicate that Africa is due for a swift modernization, even making no allowance for agricultural expansion. The hugely accelerated development of the continent brings the wildlife problem into sharp focus.

The Managing Director of the United Africa Company admitted that government hunters were shooting game in an effort to eliminate it from proposed plantation sites, but he explained airily: "Once the game knows it is an unhealthy area it will disperse." Food Minister John Strachey, in a somewhat labored reply to a question about the fate of the wild creatures in the vicinity of the ranch sites, suggested:

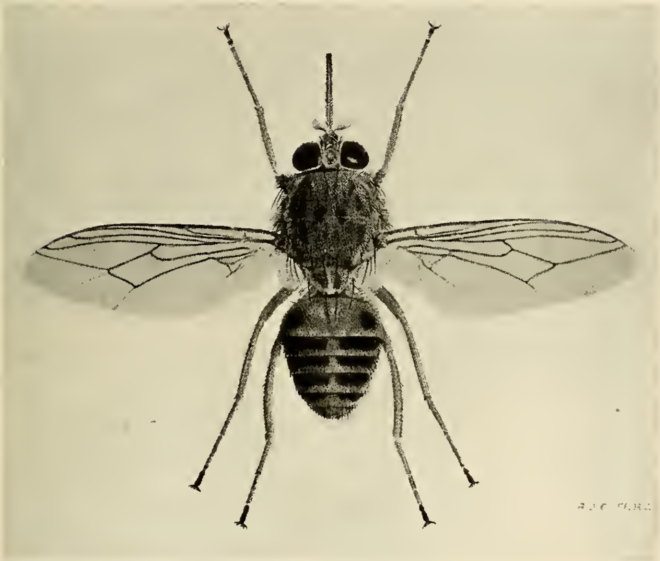
"Let me have them for our meat ration."

Whether or not it is good sense to trade the earth's most glorious animal life for peanuts, we should realize that civilization and physical development must and will come to Africa. Nothing can stop the advance, and the energies of those who would protect the game had better be directed toward seeking some formula permitting continued existence of large and representative blocs of wildlife within a civilized community, rather than jousting at windmills in a futile attempt to stem an irresistible force.

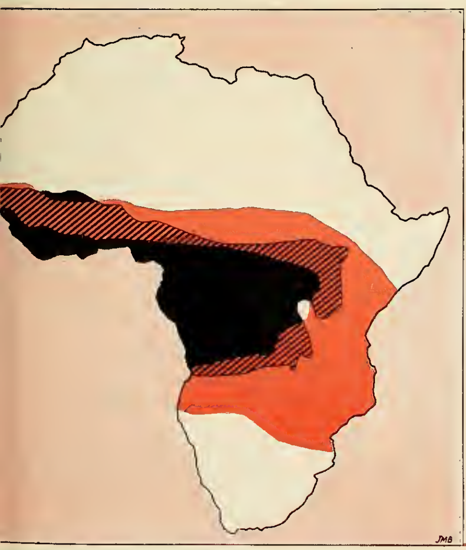
The fly called tsetse comes in many guises. At least 21 species have been recognized, all called *Glossina* something-or-other. At least some species bring sleeping sickness to man, and some cause nagana in domestic livestock. The wild animals of Africa have apparently acquired an immunity to nagana. Tsetse is probably indigenous to Africa alone.

AMNH photo

▲ **EAST AFRICAN KLIPSPRINGER**, a specialized rock antelope found wherever there are suitable rocky hills, from the Cape Peninsula to the southern border of the Sahara


After E. E. Austen and Emil Hegh

▲ ***GLOSSINA MORSITANS***, carrier of the cattle disease nagana and of human sleeping sickness in certain limited areas



◄ **DISTRIBUTION** of two of the most important tsetse flies—*Glossina palpalis* (black area) and *G. morsitans* (colored area). *G. morsitans* formerly extended somewhat farther to the southeast. The bars represent overlap

Drawn according to information from J. Bequaert, Curator, Museum of Comparative Zoology of Harvard University

The flies feed only on blood, and although some few types can live on cold-blooded creatures, such as reptiles, most depend on the warm-blooded mammals. Some species of *Glossina* concentrate on large game animals, and some on the smaller game, like wart hogs or bushbuck. The female fly hatches one larva at a time, leaving it to pupate in the earth. The fly merely acts as an agent, or insect taxicab for the disease, sucking up the pathogenic trypanosomes from an infected animal with the blood it drinks and passing them with its saliva into the blood of some other creature.

Dangerous though the flies are, they have two weaknesses through which they may be controlled. One weakness is their comparatively

AMNH photo

▲ WHEN white settlers first came to South Africa, the dry plains were covered with vast herds of antelope. Remaining wildlife is now seriously threatened. *Left*: springbok; *center*: white-tailed gnu, or black wildebeest; *right*: blesbok

slow rate of reproduction. The other is the very high degree of specialization achieved by all known species. "Some species require a high degree of shade and humidity," said the British scientific publication *Nature*. "Some are confined in their distribution to riverbanks and streams. Others require dense shade and are limited to forests; again, others prefer more open parkland." This specialization suggests several means of controlling the various species, but many methods have been tried, and most have been abandoned as impractical.

Much of the bitterness against the fly is attributable to the many tragedies it has brought to frontier stockmen. The High Commissioner of South Africa at London, Heaton Nicholls, recently described attempts of settlers to start a livestock industry in Zululand, northeastern Natal, after the first World War. Cattle died by the thousands from nagana, and many of the farmers went broke, he said. Other accounts said that the farmers, suffering at the outset because of the partial depletion of their herds by nagana, forced partial extermination of the game in near-by Umfolozi Reserve. Once the game disappeared, these reports said, the tsetse, far from conveniently dying out, left the reserve and concentrated on the susceptible livestock herds in earnest, wrecking many a farmer's hopes.

Extermination of the game in many areas of southern Africa was accomplished haphazardly, as a natural outgrowth of the expansion of agriculture and in accordance with no predetermined plan. But many persons noted that when the game went, it took with it the dreaded tsetse. And in what will probably become the Empire's next dominion, Southern Rhodesia, where the Matabele wars took place a scant 50 years ago, a calculating, methodical plan for wholesale game extermination was conceived as the best means of controlling tsetse. That this program was effective in controlling at least one species of the deadly *Glossina* is undoubted, and that it is as yet the only tried and true means of doing so is equally true. But farseeing scientists and nature lovers, noting the influential lobbying for extension of this drastic scheme through all British Africa, have fought back bitterly, urging that more time and money be devoted to research. Their job is enormous and it may be impossible.*

But the British are the world's most determined and practical conservationists. They are gradually rousing to meet the threat, although as yet with too little. Many naturalists fear the effort is too late. In no other country has a similar problem ever been satisfactorily met. Witness the fate of the bison in the United States and of the vicuña in South America. In Africa the problem is still more pointed and difficult, but the rewards for success would be infinitely greater. It is one of the miracles of evolution that the incredible richness of the animal life of Africa was spared to modern man. To shoot such a divine gift into oblivion without making a strong effort to find some other way to control disease-bearing flies would be a hideous mistake.

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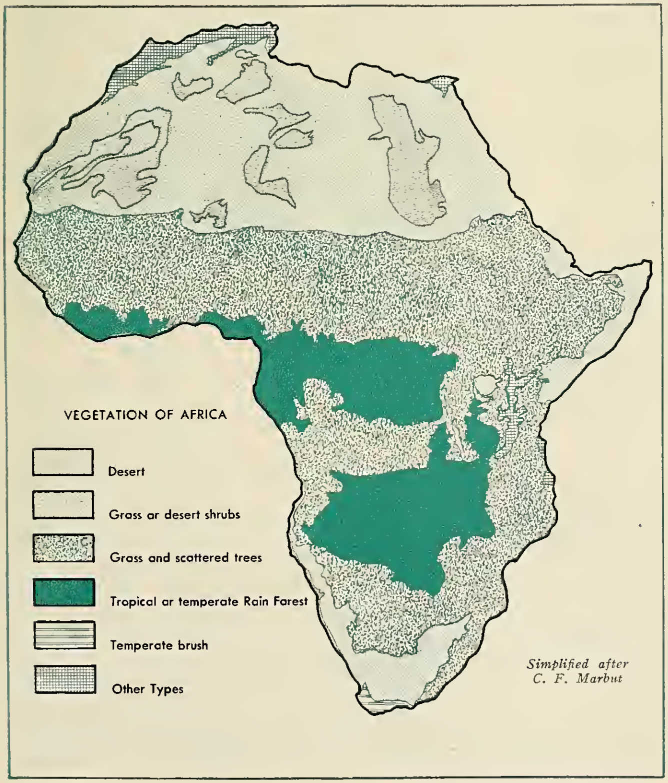
* As this article goes to press, announcement is made of a new drug, antrycide, which is claimed to cure Trypanosomiasis in cattle and to safeguard healthy animals by injection. This is an example to reinforce our trust in science. But there is no prospect that this particular discovery will promise greater security for wildlife, and cautious scientists are inclined to await further tests of its value.—ED.

"Beyond the human inhabitants there will remain, one hopes for centuries to come, the wild animals which make [Africa] so attractive to the lover of nature," elder statesman Jan Christiaan Smuts, said at Oxford eighteen years ago. "I look forward to the time when the rage for destruction will have disappeared, when the senseless slaughter of wild fauna will be as criminal and contrary to public opinion as cruelty to humans . . . Africa will be a place of refuge, a temple set apart where the human spirit can once more practice nature worship and enjoy peace and quietude." Less than a score of years later the fauna of Africa were facing their gravest threat!

The *Times* of London, a publication great enough to realize that the preservation of the animals of Africa is vital news today, recently devoted two half-columns of its critically short newsprint to an editorial-page discussion of the problem. The anonymous article inspired a series of letters from the *Times*' remarkable circle of readers.

"Because of the vaunted success of butchery in Southern Rhodesia, game extermination is being vociferously and influentially demanded in the British colonies of East Africa," the *Times* article said, but it recognized that "the tsetse fly presents Africa with a problem which must be solved in the interests of human health and the health of domestic cattle." The fly is extending its range into many areas where it previously was unknown. In a letter to the newspaper Elspeth Huxley, born in Kenya and a well-known woman writer on African affairs, warned that it "is advancing almost everywhere and in Uganda is threatening the very survival of the livestock industry. Seven-eighths of Tanganyika and three-quarters of Uganda are now said to be unsafe for domestic animals." The *Times* admitted that it was a most complicated problem but was reluctant to concede that its solution lay beyond the capacity of intensive scientific research.


VEGETATION OF AFRICA
Desert
Grass or desert shrubs
Grass and scattered trees
Tropical or temperate Rain Forest
Temperate brush
Other Types
Simplified after C. F. Marbut

Most widespread is the fly called *Glossina morsitans.* It is found in Kenya and is the main tsetse species in Northern Rhodesia. It is common in Tanganyika and has also reached Uganda. Almost as widespread are *G. palpalis* and *G. tachinoides.* All three transmit both human sleeping sickness and nagana.

But many authorities agree with entomologist W. H. Potts, director of a small tsetse research station at Shinyanga, Tanganyika, that the fly is "being used as a stick to beat the game." The bitterness of the struggle between the conservationists and the destructionists was reflected in letters to the *Times.* The slaughter of game was categorically supported by Professor Patrick A. Buxton, Director of the Department of Entomology at the London School of Hygiene and Tropical Medicine: "Game and cattle are incompatible," he declared, "and this would be so even if there were no tsetse." An acknowledged authority on the insect, he discussed *G. morsitans* at some length.

"Evidence of the dependence of *G. morsitans* on game is conclusive," he wrote. "For instance, if mining or road traffic disturbs game, the animals retreat, fly going with them. Outbreaks of rinderpest have more than once exterminated game over wide areas, and this insect with the game . . . Southern Rhodesia has used game destruction against this species of tsetse for a number of years. They have cleared about 6000 square miles (and have 4000 nearly clear) and have cattle on it, which could not be there if fly were present."

Professor Buxton's letter was sharply answered by elderly, genial Doctor Henry G. Maurice, world-renowned naturalist and President of the London Zoological Society at famed Regent's Park Zoo. Normally an amiable man, Doctor Maurice felt no inhibitions about assailing "that assurance of infallibility which the professorial chair sometimes engenders." Dr. Maurice remarked that "the professor is careful to confine his observations to *G. morsitans.* He thus avoids the necessity of referring to the results, fatal to valuable herds of cattle, of game destruction in Umfolozi, where the tsetse involved is *G. pallidipes*, or to the complete failure to eradicate the same species by game destruction in Rhodesia itself . . . In fairness, one thing must be said for the execution of the game slaughter policy in Southern Rhodesia. It is thorough and intelligently methodical, not senselessly sporadic. But whether it has really achieved or is achieving its object, it is too early to say. Whether it succeeds is not the question posed by those who wish to conserve the beauty and grandeur of African wildlife. The question is whether it is necessary, and whether the eradication of the fly . . . cannot be achieved by other means. [The *Times*] correspondent advocated scientific research in which, apparently, Professor Buxton takes no interest."

Dr. Maurice mentioned several experiments on methods of control. In one instance, he said, bush clearing alone stopped a "broad advance of tsetse which had driven 30,000 Africans from their homes." Combined bush clearing and controlled grass fires once cleared tsetse from 1000 square miles with no game slaughter involved, he said. In still another test, grass fires were kept out of a controlled area and the tsetse population was reduced 95 per cent.

"It would be an impertinence on my part to yield to the temptation to discuss Professor Buxton's philosophy of life," Doctor Maurice concluded bitterly. "He is a declared advocate of uncontrolled shooting by Africans . . . Unlike the professor, I believe that man has everything to gain and nothing to lose by endeavoring to keep alive, not in glorified zoos but as widely and as freely as possible, those creatures of nature which are, in the main, so much more

▼ THE IMPALLA, noted for making extraordinary leaps when alarmed. This graceful African animal prefers parklike forests and is never found far from water

AMNH photo

AMNH photo

▲ WATER BUCK and a rare lechwe in the upper Nile: two members of Africa's incomparable wildlife, now threatened by civilization's advance

beautiful than man and so infinitely less destructive and vicious."

Almost everyone who has written on the subject urges further extensive research, but not much is being done. Mrs. Huxley, who understands the problem as well as any layman, wrote: "To drive out tsetse, game slaughter must be linked with control of the density of bush through clearing, burning, and other methods, a difficult and costly business . . . There is, however, an alternative . . . [which is] to confer on susceptible animals the immunity acquired by game, or an imitation of it. This line of research is admittedly difficult." She said that so far as she knew, no such research was under way in East Africa. Mrs. Huxley visited the Shinyanga experimental station and complained that "this laboratory is staffed by [only] two scientists . . . and an assistant; they have no electric light or water and are obviously being run on a shoestring."

Apparently it is only in the Union of South Africa that a serious attempt is being made to control tsetse while preserving the game. Doctor P. J. du Toit, Director of Veterinary Services for the Union, recently told a sizable crowd of interested scientists and laymen at London of a research program in Zululand involving extensive experimentation with the miracle insecticide, DDT.

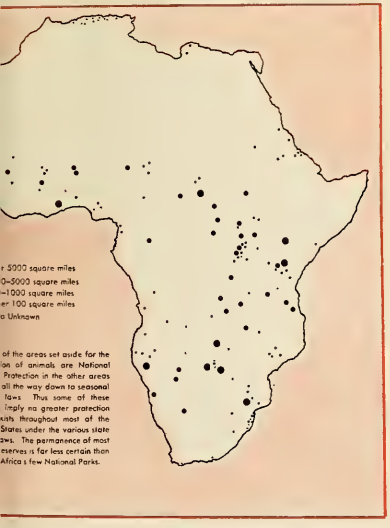
An area was selected where the tsetse *G. pallidipes* was prevalent and where the cost of bush clearing would prove exorbitant. Fly traps were ineffective in controlling the insect, and hand spraying with DDT, while extremely costly, was not efficient because the spray did not penetrate the foliage sufficiently. With the co-operation of the South African Air Force, planes were then used, operating like crop dusters. Six twin-engined Ansons, flying at 120 miles an hour 50 feet above the bush, laid long cottony streamers of DDT-laden smoke across the countryside. Some 50 acres a minute could be sprayed, and the cost per 100 square miles was about $3.60 an acre. In places where ravines or rough ground made it unlikely that the area was covered thoroughly, hand-placed insecticide grenades finished the job.

The flies were not wiped out, but the numbers remaining were very small. In view of their slow reproduction rate, they may have been brought below the "critical level" so that the fly might never be able to re-establish itself. The spraying was so successful that a temporary reprieve was granted immediately to animals that had been scheduled for slaughter, and within a few months it seemed likely that the reprieve would be made permanent. But it will take a year or more to secure the necessary evidence for a long-term decision on whether DDT can save the African game. At Shinyanga, cattle were sprayed with DDT and turned out to graze in a dangerous tsetse area. It resulted, said Caldwell, in a 90 per cent decrease in the fly, but the spray had to be renewed each two days. This worked out at an expense of about $20 an animal a day, which was, of course, prohibitive. An emulsion that will stick to the animal for a considerable period has supplemented oil sprays in the United States. Occasional deaths among cattle sprayed with DDT in the United States have prompted caution in its use.

"Sufficient has been done to justify a tremendously increased scale of operations against the tsetse fly," commented *Nature*. "The amount of money spent on research has been . . . pitifully small in comparison with the harm [the fly] causes . . . Here is a problem which requires costly, large-scale research."

Concurrent with the spread of

Continued on page 141



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eserves is far less certain than
Africa's few National Parks.

▲ MOPI,
shark fisherman of the Tuamotu Islands

The Man Who

How Mopi struggled with two sea monsters to pay off a debt

By WILMON MENARD

Photograph by the author

A FEW months before I came to the South Pacific coral atoll of Nukurua (Amanu), I witnessed a sight at the island of Rapa, to the south of Tahiti, that has made me a shark's enemy for life.

Frequently in the afternoon, off the headlands of the bay of Ahurei, Rapa, I would see schools of young whales, with occasional huge bulls. On this occasion, I saw two small whales, no doubt stragglers from the main school, tarrying and sporting on the sunlit surface of the ocean.

A native suddenly gripped my arm and pointed toward them, crying hoarsely: "Sharks!"

Rushing out through the headlands of the bay were countless sharks, swimming singly and in pairs. The young whales had been swimming over submerged coral ledges, scraping themselves as they went, probably to rid themselves of barnacles or other sources of irritation, and blood from the lacerations may have roused the sharks to special fury. In a minute or so the water bristled with the fins of the sharks as they closed in on the now startled young whales. Before the whales could sound, their flukes were ripped to pieces and their great bulks torn to shreds by the hungry, bloodthirsty pack.

Native divers, working pearl shell beds under water, have also been seized by sharks. Sometimes the monsters, with a mad wrench, strip off the skin and flesh, leaving lengths of white bone exposed. Several divers in the Dangerous Isles (the Tuamotus) with whom I have talked have been attacked by sharks while descending, and the brutes have sheared off parts of their jaws and cheeks, leaving their gleaming teeth visible forever after.

But the most wonderful story in the Dangerous Isles is the tale of how a giant Tuamotuan, Mopi by name, rode on the back of a huge shark. French traders, schooner captains, and colonial officials verified the account, as follows. While gathering pearl shells under water at the pearl-diving atoll of Hikueru, Mopi bumped heads with a shark. The creature, fully twelve feet long, circled swiftly and attacked him. Mopi, caught off guard, was forced to seek refuge in a coral cavern. But the shark lunged in after him, and Mopi, seeing no escape, struggled desperately onto its back and buried his strong fingers in the wide, deep gills.

The shark, enraged and startled, headed with great speed for the surface. There the brute barrel-rolled and leaped clear out of the water with terrifying impact, trying to free itself of its rider. It suddenly shot to the bottom again, crashing wildly through brittle coral trees and slashing Mopi cruelly. Again it zoomed to the surface, blood gushing from its torn gills. This time it headed toward a submerged reef near the native village, and there it accidentally beached itself.

The villagers, who had lined the coral strand to watch Mopi's amazing ride, attacked the shark with spears and clubs. Mopi walked unaided to the beach, his entire body torn and bleeding from the shark's rough skin and from collisions with coral. Then, seized with blind rage, he whirled around suddenly, ran back to the shark, and gave it a smashing blow on the snout above the jaws with his fist. But at that moment, the shark's jaws flashed wide—and Mopi's hand was gone!

I had always hoped to meet this extraordinary Tuamotuan, and one morning on Amanu my wish was fulfilled. A loud, yodeling call aroused me just after dawn, and when I stuck my head out of my palm-leaf hut, I saw a Polynesian giant standing beside a beached sailing canoe. He wore only a blue-and-white *pareu* tied around his strong, bulging loins. His muscular body was marked by long, serrated, livid scars, the telltale decorations of a veteran shark-killer. His head was massive, with tight, crisp ringlets of hair hanging low over his wide forehead. His eyes were large and liquid, tender though giving the impression of absolute fearlessness.

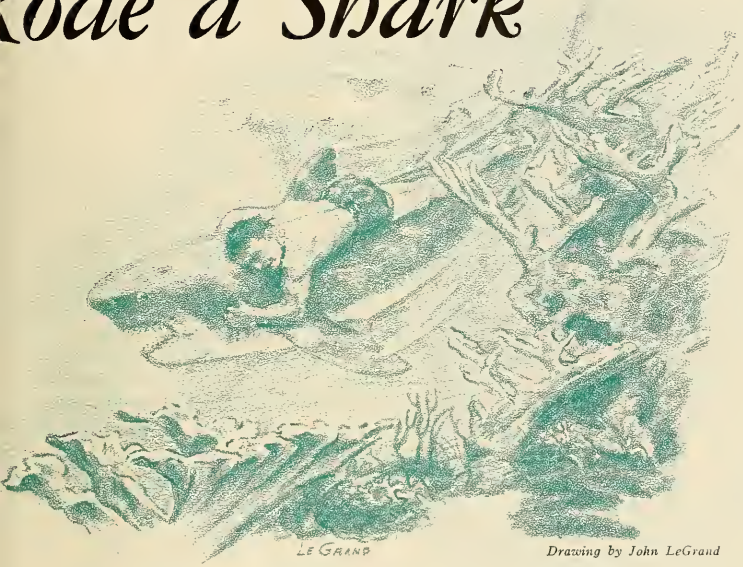
When he saw me, he grinned and waved gaily. His right hand was severed at the wrist.

"'Ullo, big boy!" he cried in a deep, booming voice. "My name Mopi! I been Frisco! I walk down Market Street! *Yah! Vera ka hau!* Hot stuff!"

(Mopi had once voyaged to San Francisco on a copra schooner, and he had picked up an amazing vocabulary of English words.)

He rushed up to me and threw his injured arm around my shoulders in a rough hug.

Rode a Shark



Drawing by John LeGrand

"I come Amanu. I hear you no like sharks!" he shouted, blowing fumes of coconut toddy in my face. "I say, damn hell to sharks!"

Mopi shared my simple breakfast with me, and not long afterward I had an opportunity to see him under water with sharks. We hurriedly launched the canoe across the lagoon and paddled to the foraging ground of the sea gangsters. The surface of the lagoon was unruffled, and the marine garden that spread out below us could be seen as clearly as if viewed under an immense magnifying glass. The sunlight was reflected from the coarse, sandy bottom and cast shadows in coral caverns where the monsters of the lagoon were possibly ensconced. Now and again a shaft of light would transfix the sliding body of a barracuda or a small lagoon shark or the green, slimy sheen of a twisting moray. It was like an amazing kaleidescope.

When I turned around to speak to Mopi, who was in the stern paddling, I saw that he was affixing to his injured wrist a leather stirrup ending in a brass cap. In the center of the brass end was a threaded hole. He reached down, grinning, and lifted up an object wrapped in an oily cloth. When he unrolled it, I saw that it was a long three-edged knife. This he screwed securely into the threaded hole of the guard.

He shouted truculently and waved it in the air. The canoe rocked suddenly, and Mopi was over the side, with hardly a ripple to mark his descent. Through the water box, I watched him go down feet first, the knife flashing brightly in the clear water. Then, at a depth of about ten feet, he turned and shot like a torpedo, head first, for the bottom. A huge shark was cruising slowly among smaller ones. The smaller sharks took instant flight, but the monster he had singled out circled him warily at a distance. Mopi swam toward the shark boldly, the knife-arm extended. The killer swam deeper, and Mopi followed him, until I could see only a shadowy outline of shark and man. A few seconds later, they rose higher, and I suddenly saw Mopi make a quick lunge at the shark.

Mopi's face was upturned now, and I could see that he was "making faces" at the shark. Then his fixed sword flashed out, and a small jet of gray smoke was ejected from the belly of the monster. (Blood in sea water at this distance appears gray in color.) The shark was furious. It circled quickly and charged Mopi, who nimbly somersaulted, swam deeper, and then came up under the brute for another hard knife thrust. Again the native swam nimbly around a coral fan and pricked the thrashing, enraged shark. Then—danger!

A small though dangerous-sized shark came into the scene, attracted by the blood of the large one. It first saw Mopi and headed toward him; but the Tuamotuan was not to be caught napping, and when the small shark swam past, flashing its jaws for a bite, Mopi sank the knife deeply into its neck just back of the gills. The shark was moving away from him at the time and, by its own momentum, drew the knife out clean, without jerking Mopi around.

But the large shark was still to be reckoned with. It rushed in for a swift attack on Mopi, and the native jerked his body aside just in time to save his limbs from a cruel bite. Mopi apparently realized that with so much blood in the water he was exposing himself needlessly to danger, so he quickly reached out and grabbed a fluke of the big shark. He twisted his body under its stomach and, at the same time, sank his knife deeply into its belly. Then he released his hold on its fluke and allowed the force of the shark's motion to rip open its stomach.

The battle over, Mopi came to the surface, blowing his nose lustily. He was breathing in whistling gasps through his clenched teeth in the peculiar way of Tuamotuan divers, to relieve his strained lungs and accustom his lung muscles to normal action. Then he climbed unaided into the canoe, unscrewed his bayonet, wrapped it in the fish-oil rag.

He gestured down into the depths of the lagoon. "Now you do go down and give it to them."

I gave Mopi a long, dubious stare. "My good friend," I said, grinning, "when I want to cut short my life, I'll find pleasanter ways of doing it than rubbing noses with sharks!"

Mopi gave me a broad, understanding smile. "Maybe you right."

◂ Cochineal pioneers. This colony is just a few weeks old. Eventually the web will spread over the entire pad. Individuals have established themselves at the base of the spines, perhaps for protection of the young web

Photo by Helen Laudermilk

The Bug with a Crimson Past

Source of brilliant carmine dye, Mexico's tiny cochineal insect started a fabulous industry that flourished for 300 years, producing one of the most romantic products of history

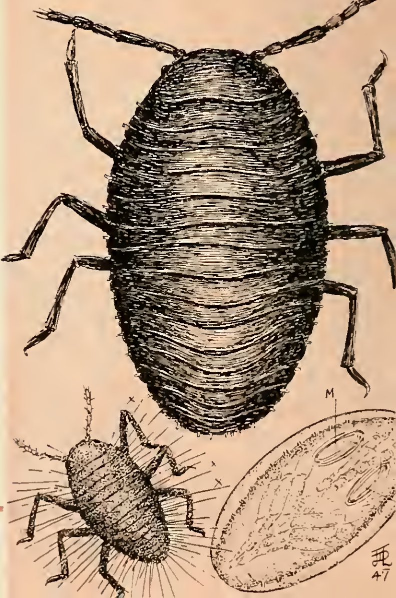
By Jerry Laudermilk

Research Associate in Geochemistry,
Pomona College

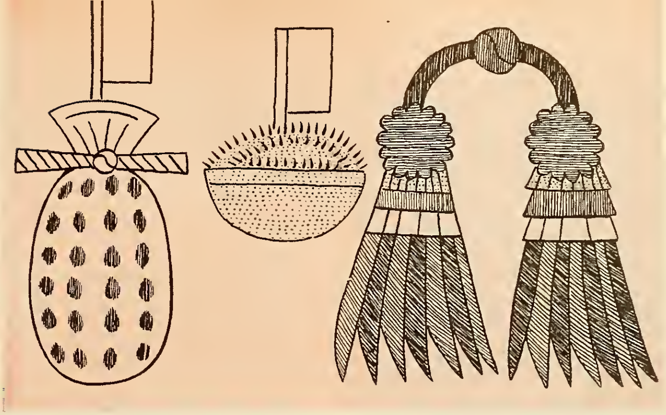
Drawings by the author

THIS is the story of an insect that once rated an important place in the tribute rolls of an empire. One of the illustrations shows three curious hieroglyphics from an ancient Mexican manuscript wherein are listed the treasures demanded of the conquered states by the Emperor Montezuma. Scanned from right to left, they indicate: one gorgeous feather diadem made from the plumage of the quetzal; twenty gourds of gold dust (you can tell that the tally calls for this number by the flag stuck in the top); and twenty sacks packed to the brim with a curious article of commerce the Mexicans called *nocheztli,* meaning blood of the nopal, or prickly-pear cactus.

▾ Wild cochineal, *Dactylopius tomento-sus,* relative of the historic Mexican variety *Top*: well-grown nymph highly magnified *Lower right*: unhatched insect. The egg-shell has been cleared with a solution of KOH in glycerine. The coiled rings of chitin (M) later become the proboscis *Lower left*: young nymph trailing filament of wax (X) secreted by special glands on the insect's back



➤ COCHINEAL "MUMMIES," with gold dust and a feather crown, represented as treasure demanded by the Emperor Montezuma from conquered states. Aztec characters from the Mendoza Codex, in the Selden Collection, Oxford, England



The feather crown and gold dust are interesting because they show the sort of company our bug kept and because her own portrait is included. The rows of oval spots on the sack are stylized pictures of the contents—thousands of tiny, dark-red mummies of cochineal insects, source of the glorious crimson dye *carmine*, one of the most romantic commercial products of all time.

I had read of this cochineal insect, *Dactylopius coccus*, and the almost magical pigment made from it, in Prescott and other accounts of old Mexican civilizations, but it was not until I came to the Arizona Desert that I made the acquaintance of this insect's relatives. In some places in the south-central part of the state, the prickly-pear cacti were white with the webs or tents of *D. tomentosus* or *D. confusus*, both of which are abundant in southern Arizona and California.

Although the two cochineal insects found in the United States are not closely related to their illustrious Mexican cousin, it is interesting to examine them. Wherever the prickly-pear cactus (*Opuntia* of several species) grows, you are likely to find some of the pads disfigured or decorated—depending upon how you look at it—by the white rags and tatters of the cochineal web. This is a composite fabric spun from strands of wax and silk. To simply scrape off a wad of the stuff and expect to see the bugs inside is a natural but unsatisfactory way to get results. The big females, sometimes a quarter of an inch long, are deep inside the tent, and the sprightly youngsters, the *nymphs*, are tiny red specks that you might easily overlook unless you used a magnifier. But pinch a tuft of the web, and the carmine squeezed out will stain your fingers bright red. Add some cigarette ash, and the red is changed to a rich shade of violet by the alkali in the ash.

The easiest way to unveil the insect population is to put a shred of web on a plate and add a drop of oil. This clears up the web in the same way that a spot of grease makes paper transparent. Now you will see bugs galore—red nymphs the size of microscopic dots and fat old mothers bigger than a match head. To see the inhabitants to complete satisfaction you need a microscope, which necessitates removing the web entirely.

Benzine takes care of the wax, and a solution of nickel hydroxide in ammonia dissolves the silk. This drastic treatment changes the population from inhabitants to specimens, ready to be examined under your microscope.

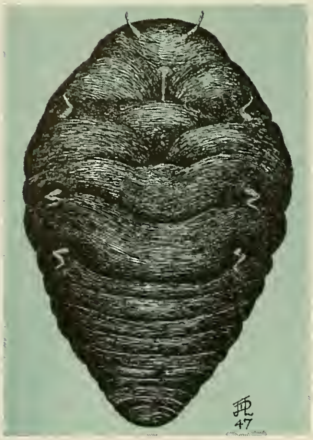
A low power, say about 20 or 30 diameters, shows the remains of what was once a teeming community made up of adults, nymphs, and eggs. (I'll not consider the case of the male bugs right now, since they lack an important feature that entitles them to a paragraph of their own.)

The eggs are tiny oval objects about an eightieth of an inch long. Since the shells are transparent, we can see the mysteries taking place inside. By selecting a series, we can follow the whole story of the bug's development from an unorganized emulsion to a larva ready to hatch.

As raw material for producing an insect, the contents of the egg seem at first to be as unpromising as a drop of mayonnaise—just a vast assemblage of oil droplets, particles of red pigment, and a myriad of ultramicroscopic specks, all floating in a clear liquid. But older eggs begin to show the ghostlike outlines of transparent infant bugs, which take shape from the emulsion as stealthily as clouds from the air.

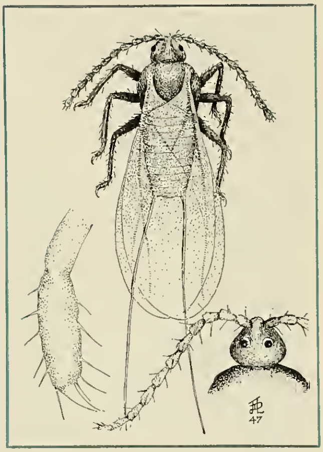
This marshaling to order of bug-stuff in response to some unknown urge within the fertilized egg proceeds unerringly, almost like the crystallization of a salt from a solution. From the start, these forming larvae show a striking feature: two circular objects that look exactly like loosely coiled rings of fine wire, one on each side of the embryonic insect's head. This is the beginning of the beak, which in the adult is an apparatus something like a built-in soda straw with a sharp point. The outlines of the embryonic bugs become sharper and sharper until the egg finally contains a neat little bundled-up insect, like the one shown in the drawing. This series, showing the development of an insect from the raw material to the finished product, makes an awe-inspiring and tremendously fascinating show.

When the egg finally hatches, the infant cochineal has embarked upon the second stage of its career. It is now a nymph, a leggy little midget which is best observed alive as it prowls among the filaments of the web. The microscope shows the nymph's outer covering to be furnished with some extremely curious organs. First there are the organs of touch, the *setae*. These are short, cylindrical, stubby-looking objects arranged in six rows



◄ A FULL-GROWN MOTHER COCHINEAL ready to lay her eggs. She is now merely an overstuffed sack with undersized legs, beak, and antennae —and packed full of eggs

▼ ADULT MALE COCHINEAL (*top*), *Dactylopius tomentosus*. *Lower right*: the head from beneath showing the lower pair of eyes. The other two sets are located on the top of the head (*center figure*) and at the sides (*not shown*). *Lower left*: the foot with its single claw, a typical feature. All figures greatly magnified



down the back, with six setae to each segment. Look a little closer and you will notice groups of small circular objects that look like pores. These are the openings—nozzles, you might say—to the cells that secrete wax, and through these the waxy threads flow out in somewhat the same way that tooth paste emerges from the tube.

These nymphs are decidedly different from the classic variety, since they are of both sexes. They all look alike at first, but each time they molt—and they shed their skins about four times—their similarity decreases. At first the nymphs stay in one place and gorge themselves with sap. This heavy feeding causes them to grow rapidly, and they soon settle down to being cochineal insects in a serious way. The males lose their nymphlike features and spin tiny white cocoons, in which they molt two or three times more —something like dressing in your sleeping bag.

The female nymph spins no cocoon but also molts, and with each change of costume she becomes plumper and plumper. With her last change, she becomes simply an egg-laying machine and looks a good deal like an overstuffed cushion. This is her final appearance as an individual. Her next role is that of an efficiently packed egg case, and I mean just that. What was once the skin of the mother is now a sack filled with eggs.

The remarkable characteristic of the male cochineal is the feature it lacks. His mouth parts are undeveloped, and during his entire life span such prosaic activities as eating and drinking are impossible. But this is really a matter of small importance, since he leaves his cocoon charged with enough energy to carry him through his entire career. The males are hard to locate. In the first place they are scarce, being outnumbered by the females by about 200 to 1. In the second place they are small, only about a sixteenth of an inch long. Although they have bright red bodies, they are practically covered by a pair of delicate white wings, neatly folded down the back and matching exactly the white background of the web. Although nature neglected the mouth, she furnished the male with three sets of well-placed eyes. He has one pair on top of his head, another on the sides, and the third underneath, in about the same position they occupy in the human face. Finally, two long, flowing streamers of white wax, which appear to be entirely ornamental, are attached to the terminal segment of the abdomen.

The wax web is the only protection that the cochineal has against its enemies, which include ants, beetles, field mice, birds, and a slick, pink grub that resembles the larva of a ladybug. The pink grub is the most dangerous of the lot, since it is able to deal with the baffling tangle of sticky threads which is a regular snare for other tiny marauders. The grub mines deep into the web, where it preys off the helpless, overstuffed mothers.

Through a microscope, an old cochineal tent is a wilderness of horrors, for it is littered with dangling skeletons of ants and spiders, the armor of departed beetles, dilapidated cradles (abandoned cocoons), and ragged old clothes (molted skins). Birds and mice learn to leave the webs alone, because bills and teeth gum up so thoroughly on the wax that the bugs are not worth catching.

This short survey of the personal history of the cochineal bug brings us to the next phase of the subject, the reason why *nocheztli* held such an important place in the culture of Mexico and elsewhere.

Normal folks like color in their surroundings, and the fact that colors have an effect upon the emotions has been known for ages. Shades of red, orange, and yellow stimulate. Blues and violets have a serene effect. Greens and cool grays relax the nerves, while drabs—dull browns and black—are sobering or depressing. Some shades of red are always a leader in a color scheme, and their presence or absence is usually noticed. Weavers, dyers, and painters have constantly been on the lookout for new shades.

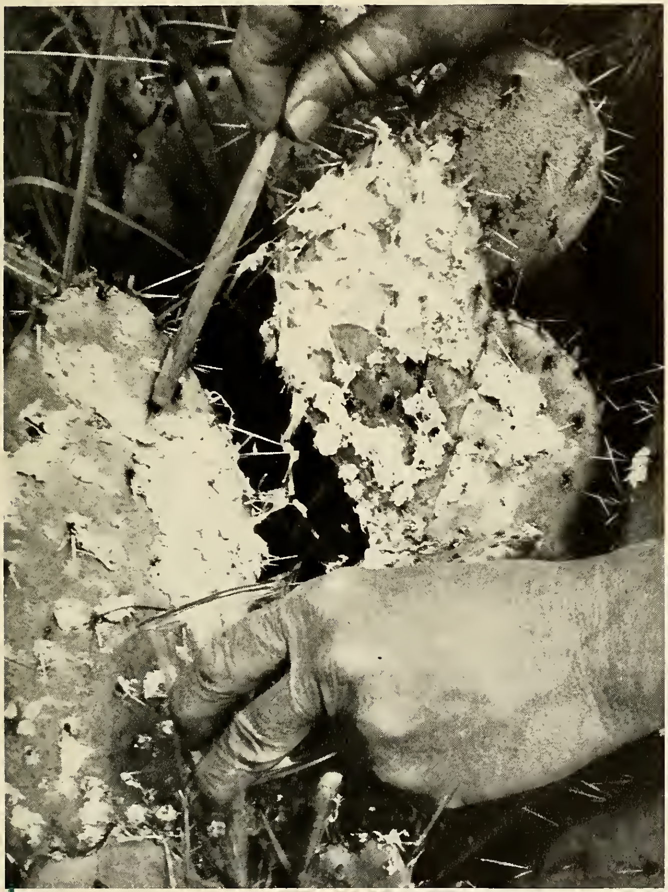
For centuries, possibly thousands of years, the craftsmen of Asia and Europe understood the secrets of making several shades of red dye. Some of these were actual chromatic "knockouts," although prepared from curious raw materials. One beautiful red was produced by kermes, an insect (*Coccus ilicis*) living on certain species of European live oak, particularly in Spain. It produced what was known as *granum tinctorium*, or red dye. The kermes insect could be gathered only with difficulty, but in early times many of the inhabitants of Murcia made a precarious living by collecting it. It had to be scratched from the twigs with the fingernails, since any other means was said to damage the product.

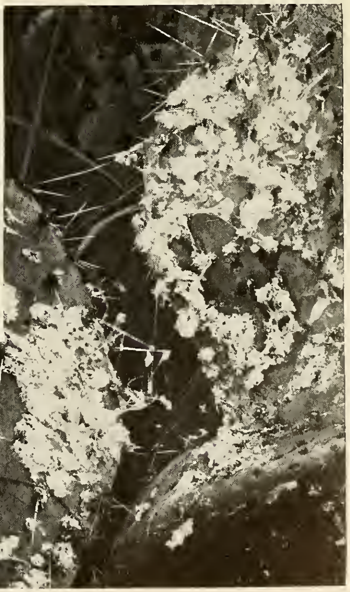
Kermes had long been known to the eastern races, especially the Phoenicians, who knew the dye under the name of *thola*. Since this was one of the finest dyes of ancient times, it is generally believed by students of the subject that the scarlet used by the Hebrews for dyeing the curtains of the tabernacle was kermes. The name kermes itself is Arabic and is the source of our own word *crimson*.

Another powerful red dye of ancient times was the Tyrian or Imperial Purple of the Romans. This was produced from two species of shellfish by a difficult and smelly process involving the use of steam heat. The color ranged from amethystine violet to true purple, producing a shade of red so deep that, like the reds of some roses, it looked almost black unless held at certain angles to the light. This dye was so tremendously expensive that a pound of wool dyed with it cost the equivalent of $235.

Among the other red dyes was *madder*, produced from the root of three or four common plants growing from eastern Europe to the Far East and related to our common weed, bedstraw. This was one of the cheap reds of olden times, a loud, red-flannel red of about the same shade as our modern Turkey red.

So, as matters stood at the beginning of the sixteenth century, the known possibilities for preparing satisfactory red dyes from the materials then available in Europe had been exhausted. The technical processes for using the old dyes had long been mastered, and perfect fastness to light and water was the rule. Some of these dyes were so





Photos by Helen Laudermilk

⮝ Collecting specimens of *D. tomentosus*. Nymphs are brushed into the beaker with a squirrel-tail brush

➤ Old colony of cochineal insects on cactus *Opuntia vaseyii*. The white web protects thousands of the insects during all stages of their development good that early Coptic yarns (fourth to seventh century) and later Flemish yarns (fourteenth century) have decayed without the colors fading. But then as now, experts in the dyer's art were ever alert for new shades and sources. A fresh field opened up in 1519, when Cortez invaded Mexico.

One of the many aspects of Mexican life that profoundly impressed the *conquistadores* was the vast size of the *tianguez,* or great market of the Mexican capital. Here, among other strange articles of merchandise, were bales of cloth so finely woven and brilliantly dyed that they brought to mind the silks the Spaniards had seen in the markets of Granada. Much of this cloth was cotton, but there were also mantles woven from extremely delicate yarns spun from rabbit fur and dyed a powerful, soul-stirring crimson. This was, of course, the carmine dye of the cochineal.

Here, obviously, was a new product with great commercial possibilities, and samples of the new dyestuff were sent to Spain. By about 1523, the Spaniards in Mexico were shipping home as much of the cochineal as they could possibly obtain.

Now, although the Aztecs used the dye with complete success on their fabrics of rabbit fur, it was only fairly satisfactory on European wool. However, cochineal had points in its favor. For one thing its tinctorial power was ten times that of the old kermes. So for more than a century after its discovery, cochineal was the subject of much trial-and-error experimentation.

As with most other natural dyes, the secret of success lay largely in the mordant or "chemical go-between" that precipitated the pigment on the fiber in an insoluble condition. With kermes, the mordant was alum; other dyes required ammonia, salts of iron, tartar, borax, etc.; but alum was one mordant of wide application. Attempts to make a satisfactory cochineal scarlet with any of the mordants in use at the time was only fairly satisfactory. All this changed about the year 1630 (some authorities say 1650), when, as the result of a lucky accident, the Dutch experimental chemist, Cornelius Van Drebbel, discovered that the proper mordant for cochineal was tin oxide. This mordant is prepared by dissolving tin in aqua regia, a mixture of nitric and hydrochloric acids. When this "tin salt" is added to a cochineal dye bath and the solution boiled, tin oxide is precipitated, carrying the coloring material—carminic acid—along with it. A chemical attraction between the wool fibers of the yarn and the tin oxide causes the pigment to become permanently entrenched, so that the dye is not just a weak, superficial stain to wash loose with the first touch of water.

This discovery was the making of cochineal. It had "made good," and soon after, the dessicated bugs were being shipped from Mexico in great quantities.

There was still much mystery as to the actual nature of the dyestuff itself. Most folks were sure that the tiny dry grains were a seed of some sort. Others contended that it was a dried berry. A few thought it might be a dried insect. The credit for clearing up this point is generally given to the Dutch microscopist, Loeuenhoek, who settled the question in 1704. But Dr. John Hill, who published a work on natural history in 1752, said that a couple of merchants who dealt in the dyestuff had an argument concerning the actual nature of cochineal and finally bet on it. The point was decided on the sworn testimony of observers who had seen cochineal prepared in Mexico. Dr. Hill himself had some peculiar ideas on the subject. He said, "The male is a kind of little fly while the female is a *reptile* without wings."

Within a short time, cochineal was being raised in Spain, Italy, North Africa, and other countries where the nopal cactus could be grown. All one needed to begin cochineal culture was a stand of cactus and a few hundred healthy insects. You fastened small fiber baskets, each containing about a dozen egg-filled mothers, to the sunny sides of the pads. In about three months the nymphs would be well grown but not yet at the web-making stage. Then one sunny morning when atmospheric conditions were favorable, you took a brush made from a squirrel tail and carefully swept the nymphs into a sack. The bugs were sometimes finished off by plunging the sack into hot water; this made *grana nigra,* or black cochineal. In making the best quality—*cochinella jaspeada,* or silver cochineal—the insects were killed by dry heat in ovens. The final treatment consisted of drying the dead insects on sheet-iron plates in the sun, producing the effect we recognize in the symbolic Aztec portrayal of red spots on a white ground.

The cochineal industry flourished for almost 200 years. It was established in the Canary Islands in 1826 and reached its height there between 1831 and 1874. As late as 1871, cochineal was being produced commercially from local bugs in California and New Mexico. But in 1874, the new aniline reds, easier to prepare and almost as brilliant as cochineal (though not so permanent) practically crowded the natural dyestuff from the market. But the bugs still held on for certain specialized uses.

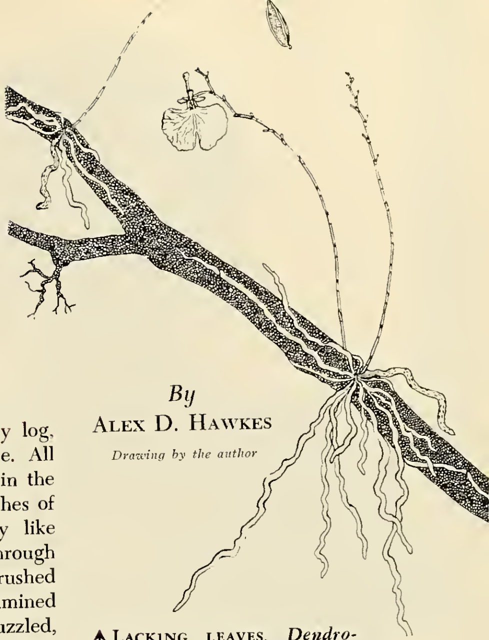
Cochineal bugs are still raised commercially in the state of Oaxaca, Mexico, and some are grown in India, since there is a constant but moderate demand for carmine. Chemists have duplicated practically every other natural dye from coal tar, but to date this is one substance that has defied synthetic duplication. Probably the bulk of the carmine produced today is used for making artist's colors and for coloring foods, drinks, and cosmetics. But a good deal is used in the fields of biology and histology, where carmine serves as a stain to bring out the structure of certain types of animal cells and tissues. It is a far cry from the crimson robes of Montezuma to the coloring in grandmother's candy—but that is the romantic history of carmine. So in memory of *nocheztli,* whose color has charmed for ages, spare the bug a thought the next time you see a cactus pad flying the white flag of *Dactylopius confusus.*

White Orchids from Cuba

The delicate flowers were like snowflakes in the hot jungle—and almost as unexpected

By
ALEX D. HAWKES

Drawing by the author



▲ LACKING LEAVES, *Dendrophylax varius* depends on specialized roots

RECENTLY, while collecting plants in northern Cuba, I had the opportunity to pay a rather protracted visit to the little-known island of Cayo Coco, one of several hundred comprising the Archipelago de Camagüey. I knew that botanists who had explored the northern portion of Cuba had largely neglected Cayo Coco and that almost anything I might find there would be of great interest to plant science.

This definitely proved to be the case. Several new records were established, and a few new species are anticipated when the systematic examination of the collections is completed. One interesting discovery was a charming white orchid, never before recorded from this section of Cuba.

I had spent a wearying day, plowing through seemingly endless scrub thickets and falling in and out of obscure pits in my search for interesting plants, and was at last making my way through still another dense jungle in the vague direction of the pounding Atlantic, which I could hear far off. My companion and fellow collector, Bill Osment, had pushed ahead a bit while I paused to examine some nice clumps of a big *Polystachya* orchid.

A loud shout from Bill brought me to my feet, and as I crashed through entangling vines and tore my already gory arms and hands on the noxious spinose bushes so typical of this part of Cuba, I drew near enough to understand his words. He had found some white orchids!

Since we were particularly interested in orchids and had been assiduously studying every one we could find, this sounded most intriguing. Furthermore, I could think of no white-flowered orchid from this part of the island, so I was puzzled as to its identity.

At last I pushed my way through a particularly dense growth and beheld Bill, seated on a mossy log, placidly smoking a cigarette. All around him, waving slowly in the hot moist shade, were splotches of pure white, looking exactly like snowflakes dancing down through the tropical air. When I rushed across to the orchids and examined them closely, I was still puzzled, but by a process of elimination their identity at last began to dawn on me. They were the elusive *Dendrophylax!*

Known to botanists as *Dendrophylax varius,* this beautiful orchid has a rather extensive distribution in both Cuba and the neighboring island of Haiti. It has been known since 1703, when the pre-Linnaean botanist Plumier described a weird "parasite" from the Indies under the name *Helleborine aphyllos, flore luteo.* It has since been renamed by several scientific students, and its presently accepted name was given by Ignatius Urban in 1918. The small genus to which it belongs is restricted to the Antilles and is placed in the subtribe Sarcantheae.

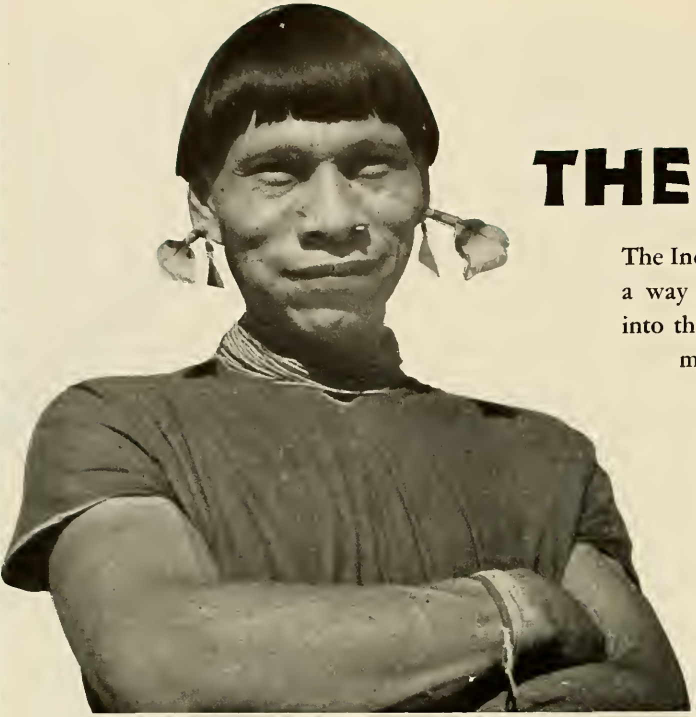
The flowers of this orchid are borne on a long, often curved stem and are usually produced singly or very few at a time but over an extended period. They measure only about three-quarters of an inch across and are pure, shining white, except for a minute blotch of brilliant yellow in the throat. The flower stems emerge from the center of a radiating mass of slim, grayish-green roots, the only vegetative parts the plant possesses. Vestigial leaves and stems may be present in immature seedlings, but they attain a size of only a few millimeters at best and are quickly lost. So this plant may be numbered among the "leafless" orchids—a strange clan, indeed! Their usually flattened roots, acting like leaves, are furnished with infinitesimal pores, through which the gases required in the photosynthetic processes are introduced and expelled, and thus they manage to survive and grow!

In the dark, damp Cuban jungle this delicate orchid has found a perfect natural greenhouse offering the conditions usually needed by plants such as these. Upon search of the vicinity, we discovered that the little white blossoms were everywhere about the trees, often in sufficient quantities to make a magnificent spectacle.

Approximately 200 species of the orchid family are included in this group of "leafless" orchids, their range extending into both hemispheres in all the tropical and subtropical regions. They are mostly small plants, usually bearing insignificant flowers; but some, such as our delightful little Cuban *Dendrophylax,* are well worth introducing into the collections of orchid enthusiasts, though their culture is bound to be difficult.

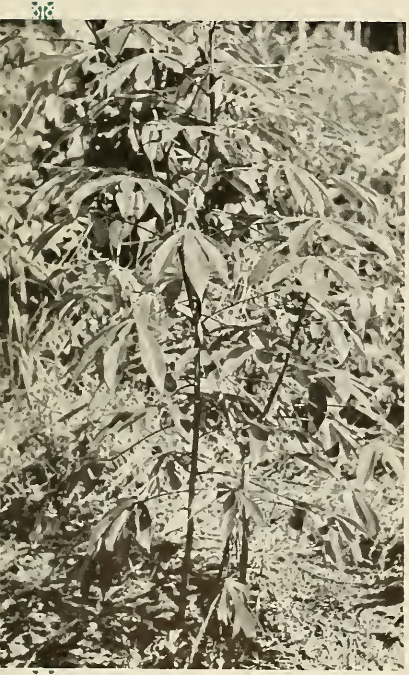
THE *Bitter*

The Indians of tropical South America found a way to change a highly poisonous plant into their chief food throughout an area of more than a million square miles



▲ A cassava eater of the Macaguaje tribe: a man with pierced ear lobes, a necklace of beads, and a *cushma* of cloth obtained from traders

▼ Cassava is a member of the Euphorbia family and is thus related to the rubber tree (*Hevea*) and the castor oil bean



BRILLAT-SAVARIN, the viola-playing author of that famous treatise on food, *La Physiologie du Gout*, put the whole matter of taste and tasting in what he considered a gastronomical apothegm. "Tell me," he wrote with his quill feather, "tell me what you eat, and I will tell you what you are." Now, contradict Monsieur Brillat-Savarin as much as you like, still he is most certainly correct in respect to the Cassava Eaters. For an Indian who eats what is known as bitter manioc has a whole culture, a whole way of life predicated on his food. Any anthropologist can depict at once the broad outlines of his life: he will be a jungle dweller in tropical South America or, formerly, in the Caribbean Isles, and he will travel about naked or almost naked. He will have, with little variation from tribe to tribe, the same type of instruments to convert this cassava into a digestible sustenance; and, finally, his entire agriculture will revolve to a large extent around the cassava grown in the clearings that he has carved out of the jungle. Bitter manioc is the most important single crop grown in the Amazon basin.

Cassava has many names—manioc, yuca, mandioca, manihot, casabi, rumu—almost as many names as there are languages in South America's Amazon. Yet no matter what it is called or how many varieties seem to exist, all are closely related members of the genus *Manihot*. And bitter manioc is surely one of the world's strangest food plants, for in its native state it is poisonous. Its fibers contain one of the deadliest poisons known to nature—hydrocyanic acid. Yet this root is food for countless thousands of Indians, of infinite tongue and name, and from cassava comes food we ourselves use almost daily on our own tables.

No uncultivated prototype of the cassava plant has yet been found. As grown by the Indians, it is a graceful, delicate-looking plant, its slender gray stems supporting compound leaves with 5 to 7 leaflets. It grows more than head-high. When the plant is pulled up, one is amazed to see the large tuberous roots on so delicate a stem. Shaped like a sweet potato and covered with a brown, almost barklike integument, the enlarged root may measure two feet in length and weigh as much as two pounds! Botanically cassava belongs to the important family named the Euphorbiaceae (after the Greek phy-

assava EATERS

By

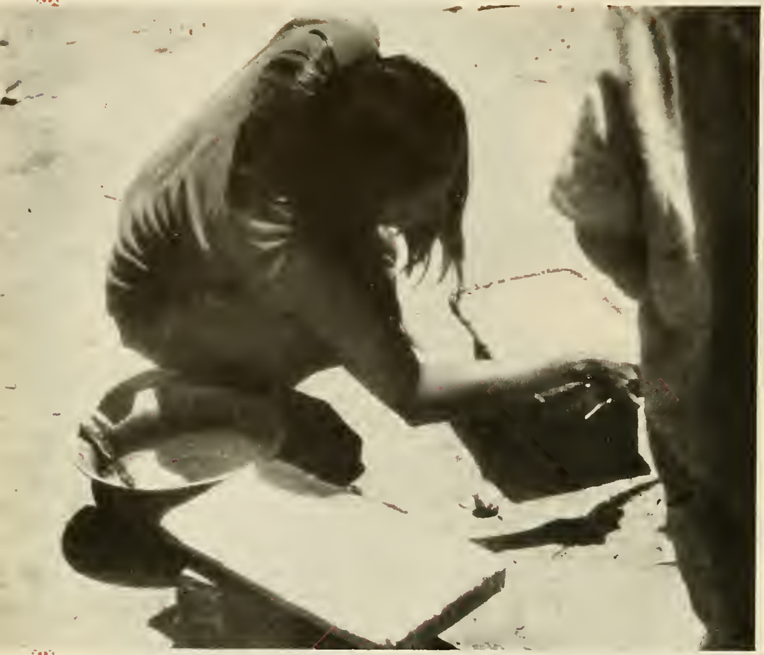
VICTOR W. VON HAGEN

Photographs by the author except where otherwise credited

sician Euphorbus), which includes some of the most contradictory of plants—the brilliantly-colored ornamental croton, the latex-yielding Hevea rubber tree, that scourge of childhood the castor-oil bean, the poinsettias, and, closer to us here, the many spurges. Many of these euphorbiaceous plants yield an acrid, milky, often poisonous juice, so it should come as no surprise that the bitter cassava (*Manihot utilissima*) has, under its barklike skin and permeating its fibers, a high percentage of hydrocyanic or prussic acid. However, it *is* surprising

▲ A MACAGUAJE CHIEFTAIN, contemplating the acquisition of an axe blade in exchange for his blowgun

▼ A COMMUNAL HOUSE of the once great Macaguajes in Columbia, one of the many tribes relying upon bitter manioc for sustenance



▲ After being peeled, the roots are grated. This Macaguaje woman is preparing graters made of spines of the chonta-ruru palm inserted in a wax-filled board. Formerly, some Indians even used diamond chips

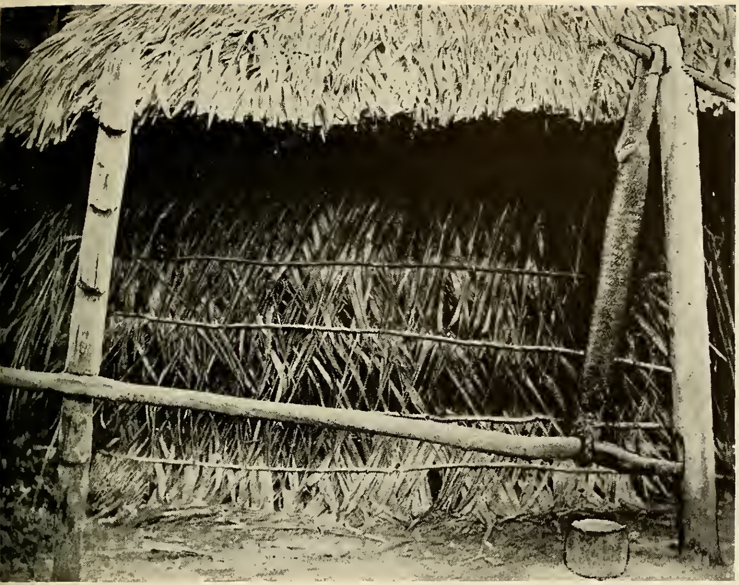
▲ Sweeping the soggy, freshly grated cassava into part of an old canoe

that the Indian should have discovered methods to rid it of its poison and convert it into food. Strange, too, for there is a nonpoisonous species of cassava, known to botanists as *Manihot aipi*. This is used by the upper Amazonian tribes of Colombia, Peru, Bolivia, and Ecuador, as well as in Central America, but it is often grown side by side with the poisonous cassava.

Who are the bitter manioc eaters? All or almost all of the tribes of the Central Amazon, whether they be the Arawakan tribes of the Guianas, the Tucanoan of the upper reaches of the Rio Caquetá, the Mojo in Bolivia, or the remnant of the fierce Caribs of the Caribbean Islands. To these people, bitter manioc in one or another of its varied forms is the bread of life. Within this vast area, as large as the territory of the United States, whole peoples are dependent on it, so much so that one might say that their relation to this poison-filled tuber is symbiotic, for neither plant nor man can live without the other. Nor does the method of extracting the poison from the tuberous roots or its preparation differ much from tribe to tribe. To describe one is to describe them all.

In the beginning, as the authors of Genesis would tell it, there is the root. It is cut from the cassava by the Indian women, for they are the agriculturists; and the stem is replaced in the soil where it will soon develop another root system. Then the roots are taken to a stream, peeled of their brown barklike skin, in which lies the greatest concentration of prussic acid. The second step is to grate the root, and the grating instrument differs considerably from tribe to tribe. The Macaguaje, one of the Tucanoan peoples of the upper Amazon (on Colombia's Rio Caquetá) make their grater from the iron-hard thorns of the chonta-ruru palm, imbedded into karamani, a wax with the hardness of cement. Other tribes in the lower Amazon use quartz flints, others diamond chips (indeed, the discovery of diamonds in cassava graters began the diamond industry in Brazil).

The grated, damp, soggy cassava



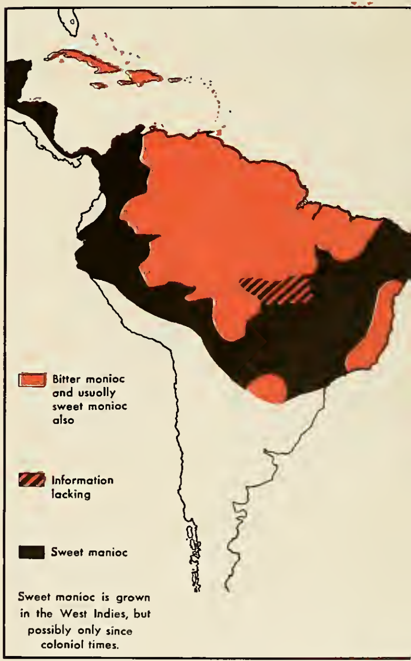
A.M.N.H. photo

◄ POISONOUS JUICE is squeezed out of the bitter cassava in the tubular basketwork container at right in this picture. The lever, locked in an appropriate notch, regulates the strain

▼ THE POISONOUS JUICE is collected in a bowl beneath the squeezer

mass is put into a basket-work cylinder, an apparatus some six feet long and three inches in diameter. A miracle of ingenuity, it is so woven that its diameter increases or diminishes when the ends are pressed together or drawn apart. It is constructed, if one's youth can be recalled, on the same principle as the finger toys once beloved by boys, from which the finger could not be pulled out unless the tube were first relaxed by forward pressure. These cassava cylinders are filled with the cassava mass and hung from the rafters. A stick passed through a loop of the press serves as a lever to elongate the press and squeeze the juice, poison-filled, out of the sieve-like openings of the apparatus. This liquid is caught in a discarded bowl and then carefully thrown away. However, in the West Indies it becomes, by primitive alchemy, a commercial product. Boiled (for boiling dissipates the volatile hydrocyanic acids) the juice becomes cassareep,[*] and is used in the preparation of the famous pepper pots of Trinidad.

This third operation, squeezing out the poison-tainted juice, converts the cassava into a course, granular meal; toasted it becomes the farina of commerce. Still another process can change it into tapioca[†] and other starch "thickeners." These are used so extensively in modern cookery that even to make a list of them would tax a Brillat-Savarin. But the Indians, at this point, put cassava meal through another process, which changes it into their food and also provides a convenient way of storing it. The granular meal is usually pounded in a mortar and sifted. Then the Indian woman puts a quantity of the material on a large, flat baking disk to form a giant cassava pancake, looking like an outsized Mexican tortilla. The heat drives off the remaining traces of poison, and the cassava bread is then laid in the sun and dried to the hardness of hardtack so as to resist the humidity of the Amazon. In this state it is ready to be eaten. It forms the major part of every meal. When dipped into their *olla podrida* of boiled fish or meat, it becomes less rocklike. Carried on the hunt, it can be broken up, reduced to coarse powder, and taken in water. Again, it is masticated



Sweet manioc is grown in the West Indies, but possibly only since colonial times.

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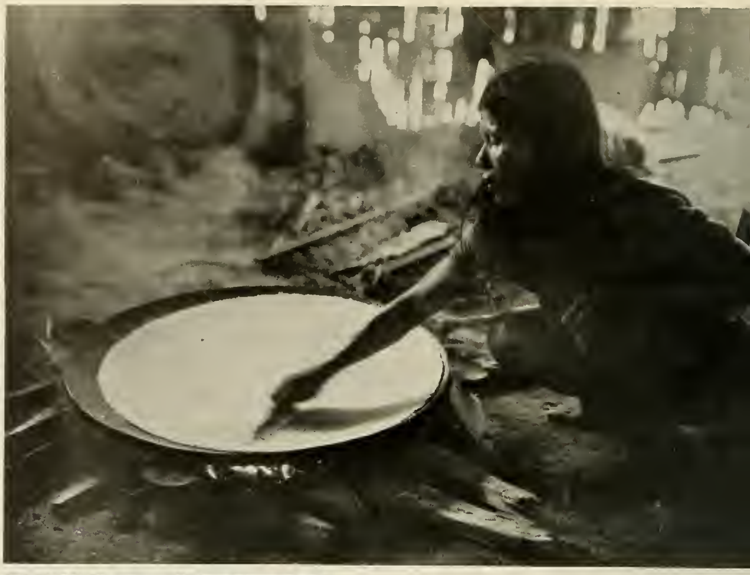
[*] Cassareep from the Carib: cachiri-poue, the juice of the cassava.

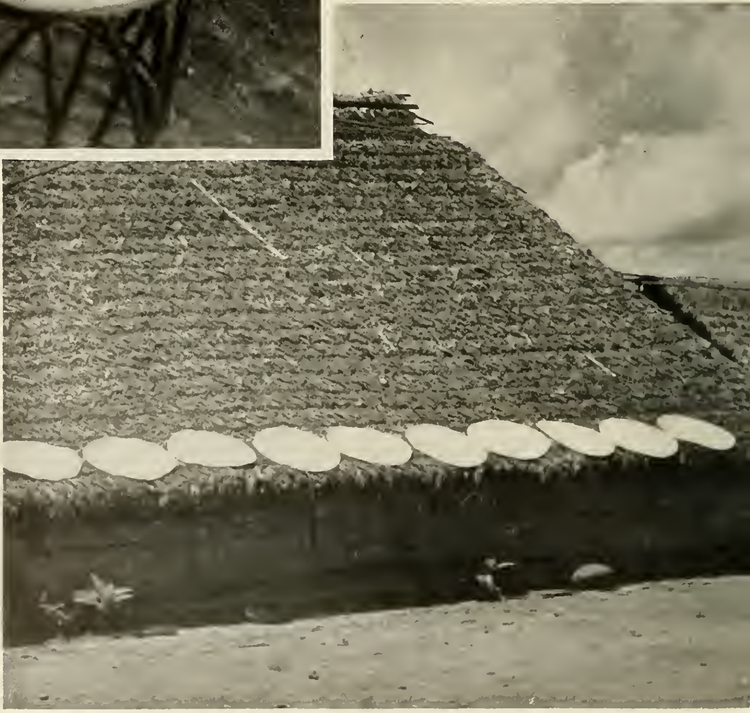
[†] Tapioca, a *Tupi* word meaning "absence of juice."

➤ AFTER squeezing, drying, pounding, and sifting, the cassava flour is baked in huge tortilla-like cakes like the one being formed here



⮟ WHEN TOASTED, the gigantic pancake is placed on the rack to dry

⮟ THEIR PLACE in the sun: cassava bread hardening and seasoning under the Amazon sun. If kept dry, this outstanding food of tropical South America will last for weeks, months, or years



by the women (chewing changes the starches into sugar), spat out, mixed with water, boiled, set aside, allowed to ferment, and, within thirty-six hours, it becomes a maltish-tasting brew. If drunk in Indian quantities—two gallons at least—it will have enough "kick" to create nightmarish visions.

Not that cassava is utterly unique. For if one were to enumerate the foods America gave the world—the potato, tomato, chocolate, lima beans, corn and squash—the list would extend through the greater part of our daily sustenance. But bitter cassava is unique in that it can only be made edible by an elaborate method of ridding it of its poison. Even a chemist will applaud the methods devised by the Indian for accomplishing this.

AUSTRALIA'S
Stinging Trees

Each hair is like a hypodermic needle equipped with a poison-filled bulb at its base

By G. H. H. TATE

Curator, Department of Mammals, American Museum of Natural History

NO one who has felt the intense pain caused by the sting of a stinging tree can forget the experience. The effect, when no more than a mere inch of skin has been brushed by the harmless-looking leaves, is agonizing. When, as happens every year in Australia, some heedless picnicker clad in summery garments trips and falls headlong among the myriads of minute venomous spicules, the result may be almost maddening.

In America many of us have come in contact with our insidious poison ivy, which often takes a full day before the irritating oil from its leaves gets fully to work. More rarely we have brushed against true stinging nettles—cousins of the Australian stinging trees—which, though they chastise us sharply for the familiarity, seldom leave an effect lasting beyond an hour. Nettles are not common in the eastern states, though I recall finding beds of them near Asbury Park, New Jersey; but in Europe they are found growing in every waste piece of ground. Children there almost all believe that the juice from the crushed leaves of common dock, *Rumex,* rubbed onto the affected place, quickly cures the nettle's stings.

As a most ill-conceived practical joke, foliage of a stinging tree was mixed with a bouquet of flowers and given to an Australian lady: "It brushed against my face. Next morning my whole head was swollen, and I could not see out of one of my eyes for some days. The pain was intense, and with this added to the great heat at the time, I suffered far more than I cared to acknowledge."

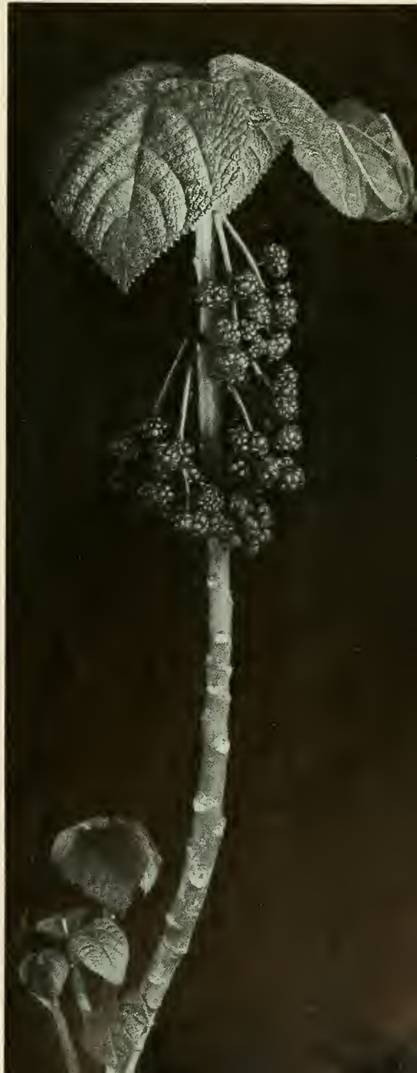
Another, suffering from the effects of the stinging tree, referred to its disagreeable but warning smell (which I personally never noticed). He also wrote that though it leaves no mark, the pain is maddening, and for months afterwards the part is tender in rainy weather or when washing.

Mr. C. R. Brown, the botanist, was stung on the middle joint of the second finger of his right hand by a single hair of the giant stinging tree *Laportea gigas.* He described his experience quite objectively. For a minute, he said, he felt almost nothing. Then the skin started to itch and burn. In two minutes pains began in the joints of the finger and at the wrist. In five minutes the pain had extended up the arm; then it gradually spread down the right side of the body to the toes and up the right side of the head. The pain increased for half an hour, after which for two hours there was such numbness that he could not hold a pencil in his hand.

Various "bush" remedies are spoken of, among them applications of wet mud and the moist inner bark or cambium of the same stinging tree. Their value is very questionable.

Other creatures besides man may be stung. Horses are reported to be the most susceptible of all animals and are said to become virtually mad with the pain and terror produced by the stings of these plants. One writer states that he knew a case of a horse so completely mad after getting into a grove of stinging trees that he rushed open-mouthed at everyone who approached him and had to be shot. In other cases, horses were reported so severely stung that their bodies and limbs became swollen,

Brooklyn Botanical Garden photo



A YOUNG, two-foot stinging tree, *Laportea moroides,* showing the reddish-purple mulberry-like fruits from which it gets its scientific name and they had to be rested for several days.

An instance is reported of a stung dog rushing about, whining piteously, and biting pieces of skin from the affected part. Cattle, too, are said to become infuriated when badly stung.

The pain produced by the stinging hairs of Australian stinging trees is like that caused by touching very hot metal—even when the touch is quite gentle. Each hair is composed of a rather soft basal bulb containing the irritating fluid and a tapered hollow needle-like end. When freshly developed, this "needle" is tipped by a tiny rounded knob, which breaks off at the slightest touch and exposes the sharp tip. The hair in its entirety works rather like a hypodermic needle, provided with a poison-filled bulb at its base.

The pain-producing substance is generally said to be formic acid. The common nettle contains .002 per cent of formic acid, but the stinging tree contains in addition .179 per cent of free acetic acid. "Plant toxins" are said by one observer to be present.

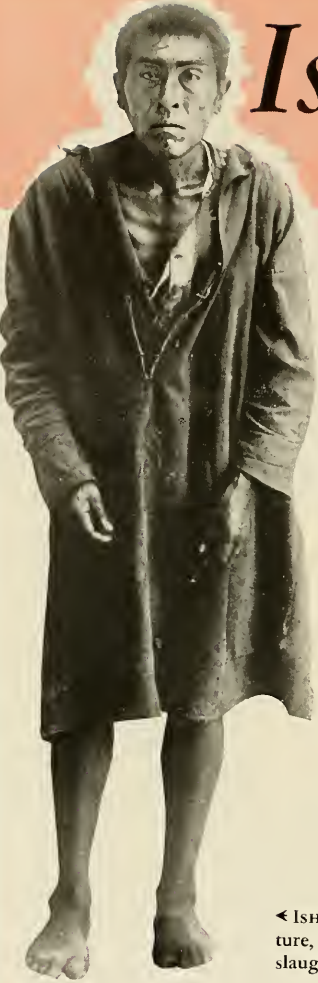
There are at least three sorts of stinging trees in Australia, all belonging to the genus *Laportea*. The wood nettle, or Canada nettle, found in eastern United States, is a member of the same genus, but its leaves only sting mildly.

The three kinds of Australian stinging trees differ greatly from one another both in appearance and stinging powers. The first is the giant stinging tree, *Laportea gigas*. This huge tree, with a trunk several feet in diameter and buttresses placed with great regularity around the base, grows to a height of 100 feet. The bark is smooth and pale gray, the wood soft, fibrous, and juicy. When the tree is cut down, numerous suckers, each covered with big heart-shaped leaves, spring up around the butt. Cut sections, like pieces of sugar cane, root readily. The tree is common in the rain forests of northern New South Wales and southern Queensland. I saw it in Bunya National Park, west of Brisbane.

The second species of stinging

Continued on page 141

Ishi – TH



When the ruthless frontier
wiped out his tribe,
he waged a lone
battle for life
in the California wilderness.
But during his declining
years he enjoyed distinction
as a unique subject of
scientific study on a
university campus

By

W. H. HUTCHINSON

All photographs courtesy University of California, Publications in American Archaeology and Ethnology

◂ **ISHI**, the day after his capture, dressed in a borrowed slaughterhouse apron

THE mountain men who blazed the overland trails to California had a low opinion of the Indians they encountered beyond the high Sierra wall. They called them "Diggers" in derision and killed them as casually as they stepped on the ants that crawled across their path. Yet of all the proud Amerinds, from Iroquois to Apache, it was one of these despised people who resisted the white man the longest—for almost 25 years after the hot-eyed Geronimo surrendered.

You skirt his country now as you drive north from Chico along the eastern side of the Sacramento Valley, on your way to Shasta Dam or Lassen National Park. The dry stream beds that underpass the highway are only names to the uninitiated — the hard, practical, Anglo-Saxon names bestowed so many years ago. There is Mud Creek and Rock Creek and Pine Creek and Deer Creek; and when you cross Deer Creek, your eyes lift unbidden to the great snow cone of Lassen Peak thrusting aside its crown of thunderheads.

Then you must forget the irrigation and the smell of green things growing in the valley to your left.

UNCONQUERED

▲ His rugged homeland: a view of Deer Creek Canyon, southwest of Mount Lassen

Then you must see, and most of all feel, the barren, arid foothill ridges lifting slowly on your right. It is a land of old lava flows, cut and canyoned by the streams you have crossed. It is a land of manzanita and bull pine and oak along the ridges, of canyons choked with pepperwood trees and poison oak bushes six feet tall and strong in proportion. It is a wild and inhospitable land to this day, and few white men live in it by choice. When you live in it as I do, you know it for the homeland, the beloved country, of the last Stone Age man north of the Rio Grande to project himself into the twentieth century.

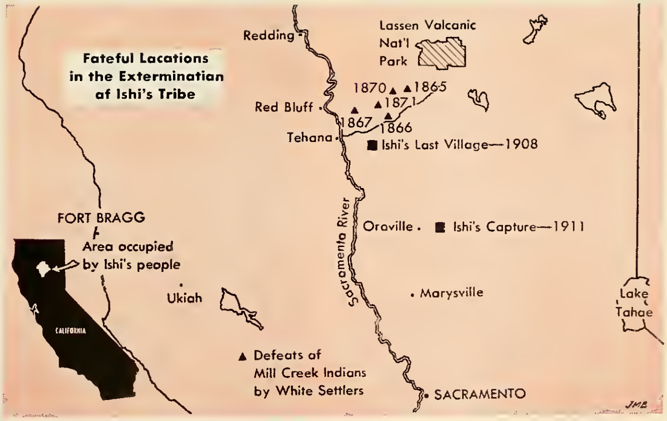
I was building a small diversion dam last summer at the head of Mud Creek, and in digging down to bedrock for the footing, I uncovered a chipped and broken arrowhead—not good flint or honest obsidian but shale, a poor substitute. With it I found a water-worked rock shaped by nature, with slight assistance, into the axhead shape that distinguishes Alley Oop. I took them home with me that night, and they sit before me as I write the story of Ishi, whose true name must forever be unknown. He was the last of his people, the sole survivor of over 60 years of unremitting warfare; and his greatest defeat—and final victory—came not from force of arms but from the white man's love of souvenirs.

Even before the Spanish came to California, more prolific tribes had forced the Yahi away from the fertile valleys along the main rivers by sheer force of numbers. The Yahi were crowded into the foothill country that no other tribe wanted, and the country itself, plus their warlike inclinations, kept them down to what their country could support.

Only rarely, and then at the risk of pitched battle, did they make forays below the 1000-foot contour into the great central valley to gather grasshoppers and then singe off their wings and dry their bodies against the hunger of winter. They gathered grass seeds along the foothill ridges and followed the harvest up the slopes to Lassen Peak as summer ripened the higher elevations. They collected acorns in the fall, and these, together with the salmon that used to throng the Sacramento and its tributaries, formed their mainstay against the starvation that always threatened if spring were long delayed. They caught deer with snares, and with skin coverings and skillful bleatings they decoyed the game within sure arrow shot; and occasionally they killed a bear, the California grizzly. Theirs was ever an economy of survival, and the white man tilted the scales against them with the finality of civilization.

The vanguard of white invasion came down the Lassen Trail—the Emigrants Death Route to California—which ran down the dividing ridge between Deer Creek and Mill Creek. The immigrants had horses and mules and cattle that were more easily killed than deer and were just as tasty. Indeed, the Yahi quickly developed a mountain lion's taste for horse and mule meat, and these they killed by choice rather than the gaunted oxen. When the Lassen Trail was no longer used, the Yahi palate led them down into the valley, where the white man had subdued their native enemies, and they raided the livestock of the outlying ranches. To lose his livestock was more than enough to make the white man wrathy, but when the Yahi compounded the felony by murdering the white man and his family, it was too much.

By the time Ishi was born into this embattled people, about 1855, their tribal strength had already



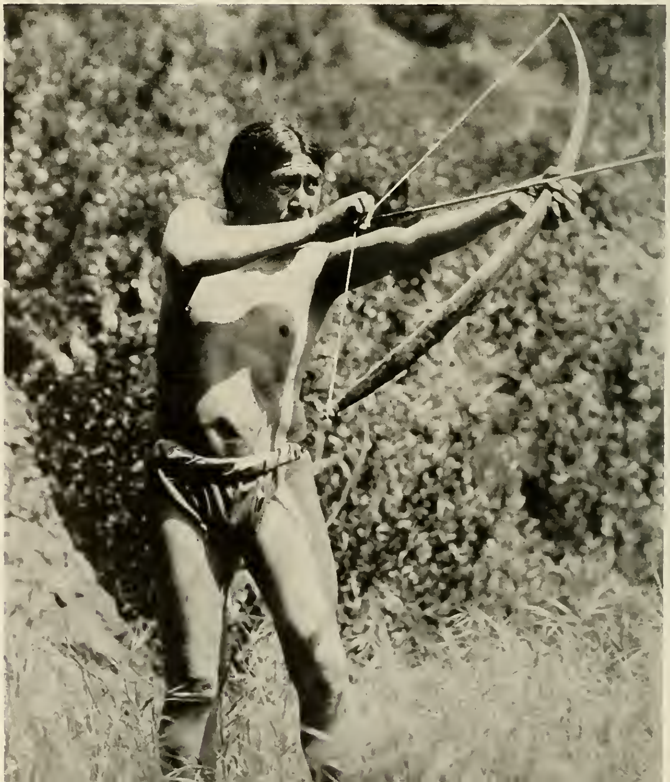
◂ CLIFFS not far from Ishi's last village

been reduced below 300 souls by almost a decade of warfare with the American conquerors of California. Before Ishi was able to walk, he and his people had become a source of revenue to the settlers. A purse of $3000 was raised by popular subscription for their extermination, and a Yahi scalp was sufficient evidence for payment.

The Yahi did their best to even the score or get a credit balance, and they killed the white man's women and children just as savagely as the white man killed their families. Ishi had his first contact with the whites as a result of the murder of the Lewis children, to which was added the theft of Solomon Gore's horses. The settlers jumped the Yahi camp in the half-light before dawn, and the Yahi lost heavily until they scattered in obedience to the ancient principle that he who runs away may get a chance to even the score later on. The victors ransacked the camp, retrieving stolen property, and when they kicked apart a heap of stolen quilts, a solemn-eyed boy about nine years old faced them stoically.

The settlers adhered firmly to the principle that "nits breed lice," and Ishi would have died then and there had not Bob Anderson intervened. Ishi was alive amidst the wrecked *campoodie* (native village) when his people returned to cremate their dead and to burn their hair down to the scalp in sign of mourning. It was a rite that was to become all too familiar to Ishi before he died.

The close of the Civil War was the beginning of the end for the Yahi. A fresh influx of settlers poured into the valley, men trained in four years of savage warfare along the Missouri borderlands. More and more cattle grazed over the ridges, and sheep and hogs were introduced to compete with the Yahi and the deer for the grass seed harvest and the acorn crop. Far away from the Yahi country, the great hydraulic monitors "piped" thousands upon thousands of cubic



➤ WHEN almost 60, he accompanied Dr. Saxton T. Pope, the archery expert, on a camping trip. He was the only person to bathe every morning in the icy waters

➤ View across Deer Creek Canyon, last home of Ishi's people

yards of gravel into the streams of the Mother Lode. Their "slickens" clogged the Sacramento, and the salmon run fell off along its upper tributaries. But Ishi and a few of his kin lived and grew wise in the desperate art of sheer survival.

Finally in 1870, Ishi came face to face with the hard facts of Yahi life. His ear lobes were pierced for ornaments, and the septum of his nose held a polished bone except when he had a cold. Then it held a sprig of juniper or bay, which acted as a primitive inhaler. He was in his middle teens, admitted to the status of a man, but there were no marriageable women left alive. It is doubtful that Ishi wasted much time bemoaning his celibacy; he didn't have the time for this luxury. The burden of food-getting was falling more and more upon his shoulders, and with his father's increasing age and feebleness, the tasks of successful leadership also devolved upon him.

In this same year, two of his sisters were captured by the whites. Ishi followed them until the approach of open country made concealment impossible; then he watched them disappear into the heat haze of the valley to end their lives on the reservation of an alien tribe.

Two weeks later, a settler named W. J. Segraves awakened one night to find the Yahi in his front yard. Segraves prepared to sell his life dearly and was understandably relieved when the men handed him their bows in sign of peace. Since the bows were too strong for him to unbend, Segraves broke them to make sure that the peace would be lasting, and the gathering spent the remainder of the night debating the formalities of surrender. After a breakfast off Segraves's cattle, provided willingly in this instance, the peace conference suddenly dissolved.

A neighbor of Segraves happened to ride over to weigh himself. When he threw the rope of the steelyard over the limb of a convenient tree for this purpose, Ishi and his defenseless people, misinterpreting this as preparation for a hanging, scattered like a covey of foothill quail. Their one gesture of submission to the inevitable came to naught despite the best intentions in the world on both sides.

The following year brought disaster to the Yahi. They stole some beef cattle in Morgan Valley and failed to cover their tracks properly in their great haste to eat. Cowboys used dogs to find their hiding place in a cave under the overhanging banks of Mill Creek. They killed everyone they found, men, women, and children, although one of the pursuers did boggle at shooting the children with his .56 caliber Spencer rifle: *It tore them up so.* He managed to salve his conscience by using his six-shooter, which was only .38 caliber. Once again the word went out that the Yahi were exterminated, but when the cowboys returned to the cave with visitors, Ishi and the little band left to him had come back and cremated their kinfolk according to tribal custom.

The only course left to Ishi and the battered remnant of his people lay in avoiding any form of public attention. He forbade stealing the white man's cattle; and any use of firearms was abandoned. The Yahi reverted to the bow and arrow, the snare and pitfall, to digging roots and spearing fishes as their forefathers. Ishi's only concession to the white man's civilization was to steal empty bottles; the glass fractured more evenly than the best flint and made the finest arrow points he had ever owned. In the ensuing forty years, Ishi lost only two of his people to the white man. In 1878, Rafe Johnson flushed two squaws out of an oak thicket, roped them both, and took them in to civilization.

Ishi had one chance, at least, to even the score ten years later when a white man crowded him too closely. D. B. Lyon was hunting deer on Antelope Creek when he heard a noise in a buckeye thicket and crawled in to investigate. He crawled out again with an arrow through his hat, not his heart, and with a firm conviction that he was a long way from where he should be hunting deer. Whether it was this incident or just the general pressure of settlement along Mill Creek that prompted the decision, Ishi led his people over the divide from their ancestral haunts into the canyon of Deer Creek to the south, about 1890.

Deer Creek Canyon is wild and deep, carved hundreds of feet below the lava rock of Deer Creek Flats, and in a tangle of shrubbery below the mouth of Sulphur Creek, Ishi cunningly concealed his village. Here the remnant of the Yahi made their home, while the slow attrition of natural causes wore them down until there were but four of them left—Ishi and his immediate family, mother, uncle, and sister.

How long they could have survived their grinding fight against starvation must remain a matter of conjecture. In the fall of 1908, a utility company decided to survey the latent power in the rushing waters of Deer Creek. It was hard, hot, sweaty labor for the survey crew but no different from other such jobs they had done—until the afternoon of November 9, 1908.

Alf Lafferty and Ed Duensing were walking back to camp at dusk this day, and as they rounded a bend in the canyon, they saw a naked Indian holding a vicious, two-pronged spear. He snarled at them, so they thought, and Alf and Ed "made a crossing of Deer Creek where there hadn't been none before." The next morning, the entire survey crew armed themselves and started a reconnaissance in force, chopping out the brush as they went to form a line of communication or retreat.

They had not gone far when they brushed their way squarely into Ishi's last refuge—three small, A-shaped shelters of brush and poles, so cunningly concealed that they could not be seen from outside the thicket or from the canyon walls above. Stirring up a pile of deerskins and scraps of canvas in one of the huts, they uncovered an ancient woman paralyzed with fright, and Miles Apperson gave her a canteen of water and left it beside her. Then the men helped themselves to whatever took their fancy—fire sticks and arrow-flaking tools, deer snares made of cunningly twisted milkweed fibers, the two-pronged fish spear that had scared Alf and Ed, and such oddments of clothing as struck their fancy, including a cape of wildcat skins. After they had satisfied their hunger for these unique artifacts, the group went back to surveying, assisted on their way by an arrow from Ishi's bow that passed between two of them.

By next morning, their consciences had begun to twinge, and they went back to the camp with beads and other mediums of exchange. They were too late! The old woman was gone, and the camp had been scoured clean of every fragment they had left behind, although under a pepperwood tree they did find a pile of glass flakings that almost filled a bushel basket—the results of Ishi's arrow-making for many years past.

The news of "wild Indians" in Deer Creek Canyon prompted a search party very different from any that had sought the Yahi in the past. Professor T. T. Waterman, of the University of California, was in charge, and he was prosecuting a matter of great ethnological importance. If the "wild Indians" were Yahi, he could fill a gap in the mosaic of California's aboriginal population. The Yahi had been believed extinct for so long that they were an almost legendary people, and their language, customs, and tribal lore were completely unknown. Dr. Waterman and his party were men of good will, but they were too late. Ishi and his family had left the shelter of Deer Creek Canyon for the higher, unprotected reaches of the foothills. It was a bitter country in which to wage a winter fight to keep alive, and the odds were all against the last of the Yahi.

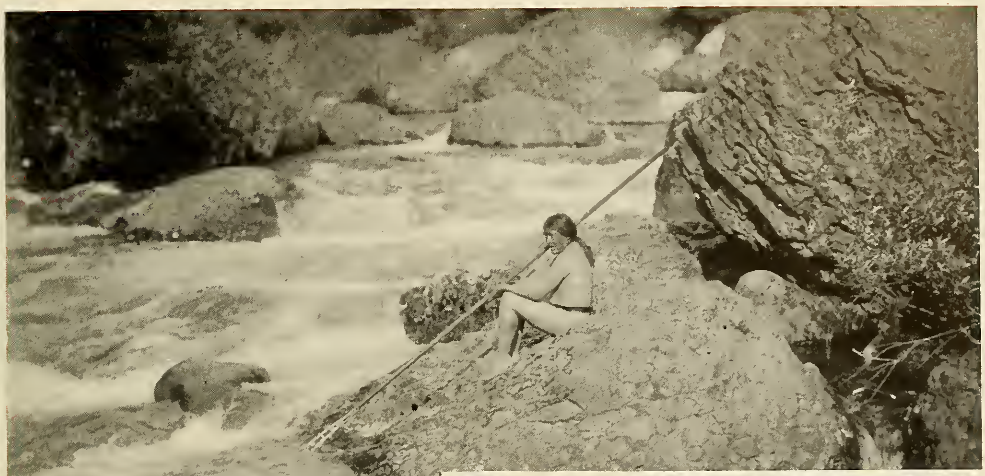
When Ishi's camp had been souvenired, it was too late in the year for him to replace his essential tools and weapons before snow flew; he had his bow and some arrows, that was all. The food they had already collected against the winter was safe, because it was ever the Yahi practice to conceal their food supply at a distance from their camp so as not to lose everything in a surprise attack. This scanty store became their emergency supply, to be used only when Ishi failed as a hunter; and it was soon exhausted.

The full story of the next three years was never known, but early in their wanderings, the older woman and the old man drowned in fording a winter-swollen stream. The next winter the younger woman, Ishi's sister, died of pure starvation, and the coyotes ate her body before Ishi had a chance to cremate it. Once again he hunkered over a tiny fire and singed his hair to the scalp in sign of mourning. For another year he pursued his lonely search for food, a search that took him farther and farther away from the Yahi homeland and led him south and east to the corral of Charley Ward's slaughterhouse.

The abattoir stood outside of Oroville, near enough for economical delivery but far enough to avoid offense. The men who slept there were awakened one August morning in 1911 by excited yelpings in the corral outside. A figure crouched in the dirt, surrounded by a circle of wary and vociferous dogs. His fragmentary garment revealed more than it concealed, and around his neck was a small sack containing a few manzanita berries. Since all their efforts at conversation were futile, one of the butchers informed the Sheriff at Oroville that they had captured a "wild man." They knew he was wild because he couldn't speak English.

When the Sheriff's deputy arrived on the scene, he commandeered a leather butcher's apron, threw it about the "wild man," and took him in custody. The best place to keep him seemed to be the insane cell at the county jail, then unoccupied, and there he was deposited but not without a rough friendliness and a sincere desire to make him comfortable. They overcame the technicality of how to book him properly by calling him "Panama Kid Webber," combining the Constable's nickname with the Sheriff's patronym. When it came to the charge, they were up against it, and he was never charged with anything more serious than being a "wild man."

When the story of his capture gained circulation around Oroville,



▲ CAMPING on Deer Creek with the white man: Ishi using a salmon spear he made on the spot

➤ A LESSON in survival methods: lashing prongs to shaft of fish spear

so many gifts of fruit poured in that the Sheriff had to make a public plea for their cessation—but not before Ishi had learned that a banana was peeled, a tomato was not peeled, and an orange was. When he sensed that there was nothing worse in store for him than a dry place in which to sleep and all that even he could possibly eat, Ishi began to take an interest in his new surroundings. This interest was reciprocated in the local press with several startling repercussions.

Ishi became embroiled in the long-standing animosity between Oroville and Chico over the proper location of the county seat. The Chico papers stood all the Oroville "wild man" stories they could take and then retaliated.

The Chico *Record* observed dryly that many nature fakers had obtained free meals and fine cigars through the gullibility of newspaper reporters with space to fill. The Chico *Enterprise* ran an exclusive story stating that Ishi was a true Indian: A half-breed of different tribal extraction had slipped Ishi the grip of the Ancient and Honorable Order of Redmen, and Ishi had come through in style.

Then the story got on the press association wires, and the St. Louis, Missouri, *Republic* editorialized in these words:

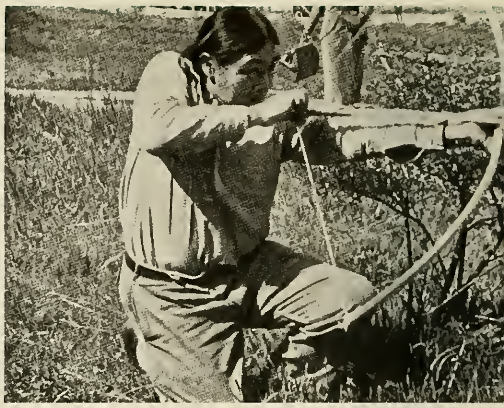
> "Here is available material for a stand-pat Presidential candidate. Here is a man without bias towards the direct primary, whose record is like virgin snow and who has never thought about anything. This last is a qualification of great value. What more could Uncle Joe [Cannon] ask?"

Besides this favorable publicity, the wire service story brought Ishi the happiest years of his life and took the Oroville authorities off the unpleasant hook of wondering what to do with him.

All efforts to dispose of their "wild man" to the Bureau of Indian Affairs, to the State or Federal authorities, had been unavailing, and when Dr. T. T. Waterman showed up with a request that the "wild man" be entrusted to the custody of the University of California, he was welcomed with open arms.

Dr. Waterman had read the wire service story about the "wild man" in the San Francisco papers, put

SAXTON POPE's close study of Ishi's archery provides one of our best estimates of an unspoiled Indian's skill



In fiction, the Indian is described as a matchless archer. True, Ishi was always the first to sight game,

on his hat, compiled a vocabulary of California Indian words, and caught the first train for Oroville. Dr. Waterman was playing a hunch that this might be the last of the Yahi, and if so, the man was certain to be in a completely primitive state, unspoiled by adoption of, or adaptation to, the white man's culture. Several of the artifacts souvenired from Deer Creek were brought over and positively identified by Ishi as his own. Then Bob Anderson came over from Chico and, from Ishi's facial expression and distinctive head shape, identified the captive as the little boy he had saved from death so many years before.

All these helped, but Waterman got his final confirmation when he was at the end of his vocabulary of Indian words. Ishi had shown no signs of recognition as Waterman worked down the list, until they came to the only word that Waterman had in Yana dialect, a linguistic cousin to Yahi. The word was *sīwin-'i,* meaning yellow pine. When Ishi heard it, his face lighted up with pleasure, and he repeated it in his own dialect time and time again. It was the first recognizable human sound he had heard since his sister had died and left him to wander the foothills alone.

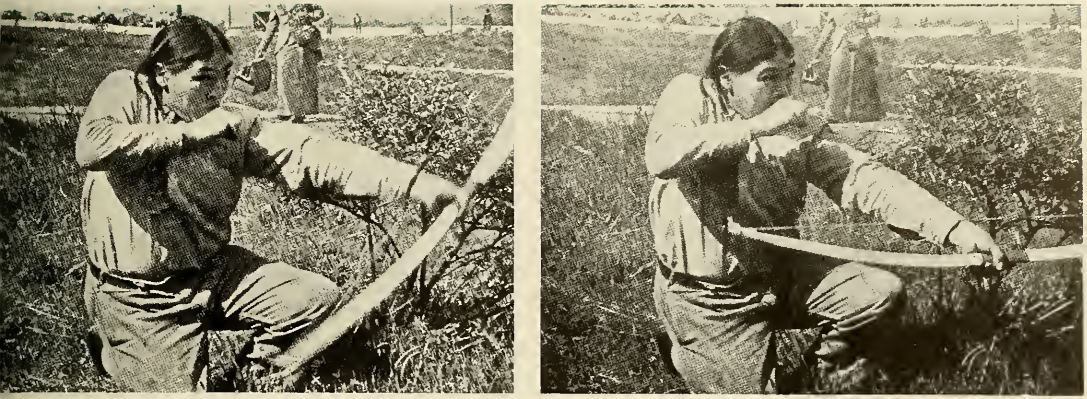
The rest of the story is quickly told. As Dr. Waterman and his ward stood on the station platform in Oroville and watched the Western Pacific Limited thunder out of Feather River Canyon and grind slowly to a stop before them, Ishi almost vomited with fright. He had seen trains before but from a great distance, and to him they were monsters chasing their prey across the valley. He had always concealed himself until they passed out of his sight. He would have bolted for the foothills except for the reassuring presence of Dr. Waterman, the man who knew the Yahi word for yellow pine.

The University put him on the payroll as an Assistant Janitor, and he was self-supporting until the day he died. The name of Ishi, meaning Man, was given him by Waterman after they had reached the stage of intelligible conversation together. His real name could only be spoken by another member of his tribe, never by the bearer himself; so as Ishi he is known to history, and the name is more apt than many bestowed at christenings.

The tall buildings that now surrounded him left Ishi unmoved. They were not nearly so tall as the majestic peaks and crags of his homeland. He was taken to watch Harry Fowler start his transcontinental airplane flight, and when the animated bird cage circled above the throng and Waterman told Ishi there was a white man in it, Ishi only smiled faintly. Automobiles did not impress him half so much as trolley cars, because trolley cars had a gong to clang and something that went *whoosh* when they started and blew dirt off the tracks. If Ishi could return to San Francisco today, he would doubtless recognize many old friends still running down Market Street.

To Ishi, the most wonderful of all the white man's ways were the things we take most for granted—making fire by striking a match, getting water simply by turning a knob, and hiding the light with a window shade that disappeared and came again whenever needed. He relished his dry sleeping quarters and reveled in unlimited food from the University cafeteria. But he used tobacco only to humor those friends who gave it to him, and when it came to alcohol, he summed it up succinctly: "Whiskey-tee crazy auna-tee die man."

These were in truth the happiest years of his life—plenty of food, clothing, and shelter; friends who were genuinely fond of him for himself; and enough work to keep his hands occupied and his heart strong. He made arrowheads, the best ones coming from Bromo-Seltzer bottles, and other handiwork which he gave away with a



and he showed great proficiency in shooting small animals. But men who had practiced the English style only a few months could out-target him. Archery was really brought to perfection only after the bow was passé

generous hand. Small boys were instinctively attracted to him, and his working command of English was learned from them with astonishing results, as when he replied to a kindly lady's query as to whether or not he believed in Jesus by saying, "Sure Mike."

Although he steadfastly refused to discuss his own family or those last three years of slow starvation, Ishi was always willing to talk about his people. What we know of the Yahi, their customs, legends, music, and tribal history came largely from Ishi, who filled in the gaps of the mosaic.

Ishi believed that "too much *wowi* (houses)" made so many white men sick. He believed that playing with dogs caused paralysis and that tonsilitis should be cured by rubbing the neck with honey and blowing ashes down the throat through a hollow tube or quill. Dr. Saxton Pope, famous physician and archer extraordinary, treated Ishi when he was sick and received implicit obedience and confidence. Pope, you see, was adept at sleight-of-hand tricks, and these Ishi knew and remembered from his boyhood. Had not the Yahi medicine men cured disease by plucking bits of stone or thorn, sticks, and pieces of down from the body of the afflicted?

It was Dr. Pope who finally prevailed on Ishi to accompany him on a camping trip back to Deer Creek Canyon in the summer of 1914, after reassuring Ishi that they would bring him back to the University. Even after Pope's reassurances, Ishi had three objections:

a) No houses in Deer Creek
b) No beds, tables, or chairs in Deer Creek
c) Not enough to eat in Deer Creek

However, they had a good trip, and Pope comments dryly, in his account of it, that Ishi was the only member of the party to bathe every morning in the icy waters and was the best dishwasher in camp.

All in all, Ishi adapted himself remarkably to the circumstances that surrounded him, and when he died of tuberculosis in 1916, he went as he had lived—without complaint, not railing against the end, with the native dignity he possessed in such great measure.

Dr. Pope and Professor Waterman buried Ishi after his tribal custom. With him in his coffin they placed his bow and quiver, some acorn meal, his fire sticks, some dried venison, and ten pieces of dentalia (Yahi money), to see him into the afterworld. After cremation his ashes were placed in an earthenware jar of Indian manufacture, and on the outside of the jar was inscribed this legend:

"Ishi, the last Yahi Indian, died March 25, 1916."

Now, Niche 601, Room B, in Olivet Columbarium near San Francisco, is Ishi's homeland forever, but his spirit must live on so long as these words of Professor Waterman remain:

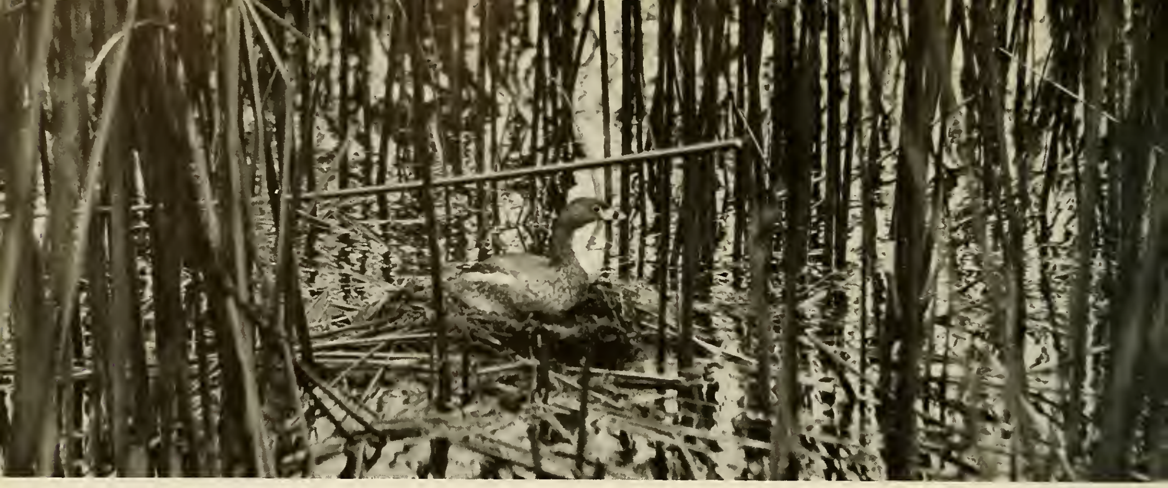
> "He convinced me that there is a gentlemanliness which lies outside of all training and is an expression purely of an inward spirit. It has nothing to do with artificially acquired tricks of behavior. Ishi . . . had an innate regard for the other fellow's existence and an inborn considerateness that surpassed in fineness most of the civilized breeding with which I am familiar."

As I look up at the broken arrowhead and the crude stone ax, I wonder if they were not Ishi's, and if they were, whether he would approve my ownership.

Ishi

Ishi's signature

For further information concerning Ishi, the reader is referred to T. T. Waterman's excellent paper in Univ. of California Publications in American Archaeology and Ethnology, vol. 13, No. 2 (1918) and to special articles by other authors in the same volume.



Wiles of the Water Witch

Now you see it, now you don't. The Pied-billed Grebe's habit of drawing a "blanket" over its nest makes it an interesting study in bird behavior

By LEWIS WAYNE WALKER

Photographs by the author

PERHAPS you know these birds by some purely local name. It might be "dabler," "dabchick," "diver," "dipper," "hell-diver," or a host of others, including the one used in the title. And as the breeding range of these birds not only covers most of the United States but also stretches south to Argentina, I shudder to think of all the other cognomens by which they are known—those of Portuguese or Spanish derivation. However, most of these localized names describe some definite trait, either descriptive or illusionary, and many of them will probably not soon be supplanted by the textbook term, Pied-billed Grebe.

In many ways these birds are really tule or cattail witches, for they are so at home in marshy waters that they can remain close to an intruder without being seen. Sometimes they dive to the depths by springing above the surface and arching into a beak-first pose. But when they desire to be secretive, they can just slowly submerge like a piece of waterlogged wood without leaving a ripple to mark the spot. They may reappear a hundred feet away and announce their location by an explosive bob to the surface, or they may come up in the midst of a raft of floating reeds within arm's length, with only beak and eyes above water level.

This trick of watching an enemy while remaining practically submerged is just one of the many ruses used by grebes in their struggle for survival. A few of these ruses follow patterns well known in the bird world, such as feigning injury with the possible result of leading an enemy away from eggs or young.* One of their tricks, however, the covering of the nest during absence, seems almost wholly confined to grebes.

Most marsh areas overgrown with cattails or tules have numerous rafts of rotting vegetation lodged on the surface of the water and held in place by growing stalks. In fact, they are so common that most observers rarely give them a second thought and pass them by without investigation. Yet one of these seemingly waterlogged piles of rubbish may be the nest of a pair of pied-billed grebes, built in a haphazard way and resembling the debris of the area.

However, white eggs are easily seen no matter how well their cradle is camouflaged. As though to compensate for the fact that their eggs are not endowed with protective coloration, the grebes adroitly execute their slickest trick. At the slightest sign of danger, an incubating parent makes two motions almost simultaneously: the body is pushed sideways toward the edge of the nest, while the beak reaches across the eggs and grasps a tangled mass of rotting vegetation. As the bird submerges, this dripping blanket is drawn over the eggs and then dropped, completely hiding them from sight. One does not know, of course, what is going on in the grebe's mind or how much of its behavior is more or less automatic and unreasoned.

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* Another interpretation of this behavior is that the presence of a possible enemy creates an emotional conflict between an innate urge to flee and one to stay on guard, producing the disturbed behavior referred to. Animal psychologists generally do not consider it safe to assume that the bird feigns injury deliberately to fool an observer.

◀ A SEEMINGLY WATERLOGGED pile of rubbish may be the nest of a pair of pied-billed grebes. It is built in a haphazard way and resembles the debris of the area

The covering of the eggs may have survival value as a protection from direct sun or by providing some measure of heat from the rotting blanket of vegetation. Or it may, of course, help the birds in their struggle for survival by offering concealment from enemies.

The grebes' return to the nest is also shrouded in an aura of deception, for during the nesting season their behavior shows every indication of distrust. The attitude of the family can best be described by the old saying, "Even the walls have ears."

Perhaps the first clue to the parents' return will be a series of cackling calls from the midst of the aquatic growth—calls that change place and direction so rapidly that the birds almost seem to possess ventriloquistic powers. The next sign may be delayed for ten or twenty minutes. Then a bird may come bobbing to the surface in the center of a clear patch of water, perhaps right at the feet of a waiting observer. It might spend the next few minutes paddling around in plain sight, pecking at inconsequential objects floating by. If this fails to arouse the onlooker's interest, the bird's tactics change again, and sometimes it will aquaplane along the surface as though endeavoring to induce a chase. In this display it holds its body in a vertical position and skids on its tail, propelled by both feet and wings.

If a chase still fails to materialize, almost anything can happen, for no two pairs indulge in the same routine. Sometimes one bird plays the dominant role while the other stealthily approaches the nest. One family that I watched for several days appeared intent on convincing me that a near-by coot's nest was their home—much to the chagrin of the coots.

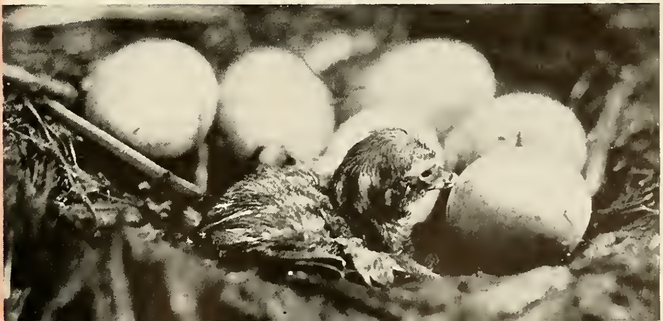
As a general rule, these noisy and visible shows are of short duration and are followed by a period when the area seems deserted. Then, if the nest is watched closely, a serpentine head may be seen to poke above the surface of the water. The bird's body will gradually follow but so slowly that hardly a ripple radiates from the spot. As the witch slides on the nest, her beak grasps one edge of the covering and folds it to one side, just as we might fold a blanket. After the eggs are adjusted under the feathers, the blanket is arranged just so, ready for instant use when needed.

On one occasion, I chanced upon a nest within a few minutes after the hatching of the first few eggs. At departure the parent had hidden the chicks under the soggy covering, but the movements of the young pushed the blanket aside and exposed them. From that moment, deceptive behavior was abandoned, and the parents resorted to outright attack. Both adults made headlong charges that brought them within two feet of me before they arched their bodies to disappear into the water.

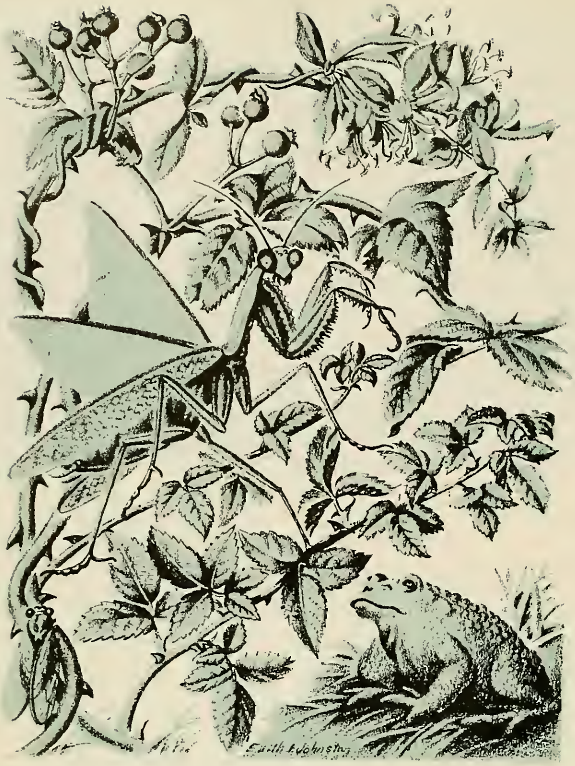
The striped young were precocious and within minutes after emerging from the eggs roamed all over the nest. But unlike the chicks of most birds, these progressed "on all fours," somewhat after the fashion that the earliest prehistoric birds may have done when they were emerging from their four-footed reptilian ancestry. Their progress through the water also differed from that of our better known aquatic birds. These young swam toward their frantic parents just as they had crawled, on all fours, with beak and wings awash and only the head held high.

➤ CONCEALED beneath its blanket of rotting vegetation, the grebe's nest may be almost undiscoverable

▲ THE WHITE EGGS are quite conspicuous when the covering is removed during the parents' absence



➤ A JUST-HATCHED GREBE among the remaining eggs



▲ TROPICAL MANTISES are said to devour small toads, but not the Chinese mantis that is common in eastern United States

Borgia of the Insect World

The cannibalistic female mantis is one of nature's most extraordinary assassins

By

EDITH FARRINGTON JOHNSTON*

Drawings by the author, from Strange Visitor, *published by the Macmillan Company*

"WHAT *is* that horrible-looking creature?"

This is a question I am asked many times every year between August and November.

The horrible-looking creature is the praying mantis. Even before she goes into action, the female mantis, with her great size, large dull eyes, long angular legs, and spiked and serrated arms, may well stop the beholder in his tracks.

During her early life, from May to August, she is so slender and so much like the green vegetation which she inhabits that she is almost never seen. East Indian natives believe that she starts as a small shoot on a plant and first achieves a life of her own in autumn, when she is full-grown. But once her life history is understood, it is fairly easy to find her by searching in the right sort of spot, even in early summer.

In the United States several species of mantises† are common. However, the one most frequently noted and collected is the Chinese form, *Paratenodera sinensis.* Its egg masses were accidentally introduced into the United States on nursery stock from the Orient in 1896. Since then it has become thoroughly naturalized and has increased and multiplied. It is one of the most useful of insects, devouring vast numbers of grasshoppers, crickets, cicadas, wasps, and even large spiny or hairy caterpillars. It has gained such a reputation as a benefactor of gardens that in some localities enterprising small boys have collected considerable numbers of the egg masses to sell to amateur gardeners.

The insect catches the attention of the layman not only because of its size, peculiar structure, and its custom of perching on penthouse porches, railway station ramps, or city fire hydrants but also because it is often noticeably colored. Entomologists tell us that, just as dark or drab-colored creatures sometimes exhibit albino forms, green or greenish insects often produce individuals of varying degrees of pinkness. Sometimes this variation takes the form of a mere shadowing of brown on legs and wings, the chromatic result of spreading pink over green. Frequently the pink has almost superseded the green on abdomen, underwings, and thighs, leaving them a true pink but qualified by the residual green to a shade known to fashion-writers as "dusty pink." And occasionally nature discards all prudence and releases to a hungry world a veritable rose-colored katydid or grasshopper or mantis, doomed, one would think, to an early death by its contrast with its green habitat. Oddly enough, many Chinese mantises with pink abdomen and underwings are captured every year—after they have survived to full maturity! Their escape from enemies can probably be explained by the fact that, except in moments of agitation, the gauzy pink underwings are folded out of sight under the leaf-brown wing covers with their birch-green edges, and the rosy abdomen is visible only from below.

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†When speaking of more than one praying mantis you can say mantises, mantes, or mantids. All mantises belong to the family Mantidae, and for this reason scientists generally prefer to call them mantids rather than mantises. The word *Mantis* designates a particular genus of mantids. *Mantis religiosa,* for example, is the common European form. However, popular usage has favored "mantis" and "mantises" as general terms.—ED.

* EDITH FARRINGTON JOHNSTON is best known to nature-lovers for her paintings of flowers. The originals have been shown from New York to California, and reproductions in current magazines have established their popularity with the general public. Her three books, done in collaboration with Margaret McKenny—*A Book of Wildflowers, A Book of Garden Flowers,* and *A Book of Wayside Fruits*—have become classics for young people's libraries. In these three books Mrs. Johnston did the color-separations for the lithography herself.

Her recent book *Strange Visitor,* a child's story of the life of the praying mantis, is gaining wide acclaim as the only popular-type book on the subject. Mrs. Johnston spent leisure time for ten summers studying and sketching mantises, for firsthand information. At present Mrs. Johnston is working on a book of 30 common Lepidoptera, with text and pictures from personal observation.—ED.

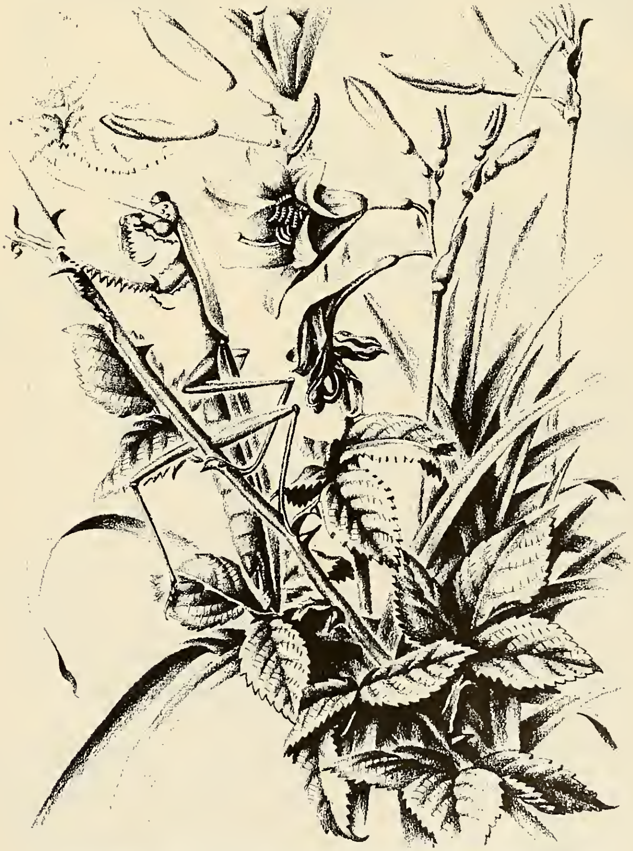
The female particularly has gained the reputation of being fierce and carnivorous, but you need not believe stories that the male contents himself with vegetable food alone, for he is just as carnivorous as the female. I have raised many young mantises straight from the egg case, feeding them on fruit flies; and if the males were truly vegetarians, they would show a Hitlerian distaste for this meat diet. I have never seen any of them discriminate against it. At the same time, if you want any males to grow up, you must isolate them at a very tender age, else they will fall victim to the cannibalistic tendencies of the females.

The female, as she matures, and particularly when she is heavy with eggs, develops a feral voracity and an ability to satisfy it, which make her a menace to all insect life. The curious thing is that insects never seem to fear her or to make any effort to escape her advances. The katydid, the butterfly, the mask-faced grasshopper, and the cricket all seem to accept her as a fellow insect and to have no suspicion of her evil designs upon them.

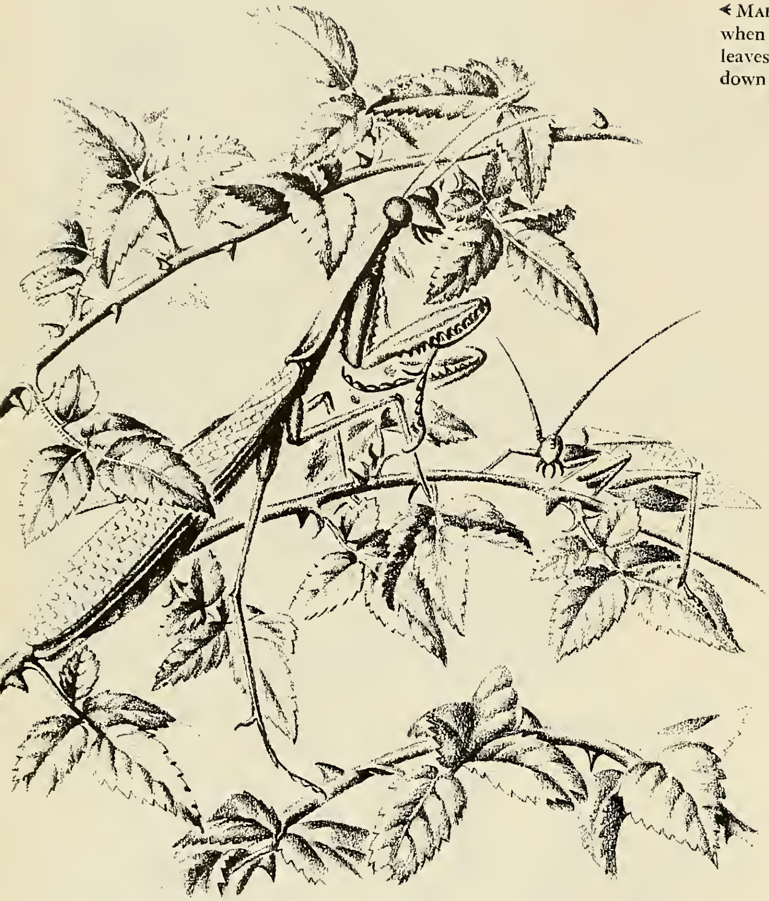
On a grassy bank one late autumn day I saw an endless tapestry of insects, interwoven with brambles, belated butter-'n-eggs, faded grasses, dwarfish goldenrod, asters, and red clover. The theme of the weaving was the hunt of the mantises for their prey, its capture and ingestion. But here was no swift action, no wild panic and pursuit. Like actors in a slow-motion film, the prey crept gently among the slanted weeds, too little warmed by the waning sun to run or leap, while the carnivorous huntresses, whose meat diet better fortified them against the encroaching chill, stalked and consumed them without haste or animosity.

Among her own kind, the female is not at all deterred by ties of kinship from eating her own siblings. Even at mating time, when a certain tenderness might be expected to prevail, she will turn her mournful head backward, bite off her husband's head, and absentmindedly start munching along down his thorax while he is in the very act of giving life to her 300 eggs!

The female mantis usually appears to be without fear. She is ready to do battle with any foe, from insect to man. Her fixed hypnotic gaze, as she slowly turns her head, follows your every movement. She is one of the few insects



▲ SHE held up her bent arm in front of her mouth, moistened her wrist, and washed her face just like a kitten



◄ Madame Mantis reared back like a horse when the katydid came jauntily along the leaves. Then—snick!—and her arms darted down like a bear trap

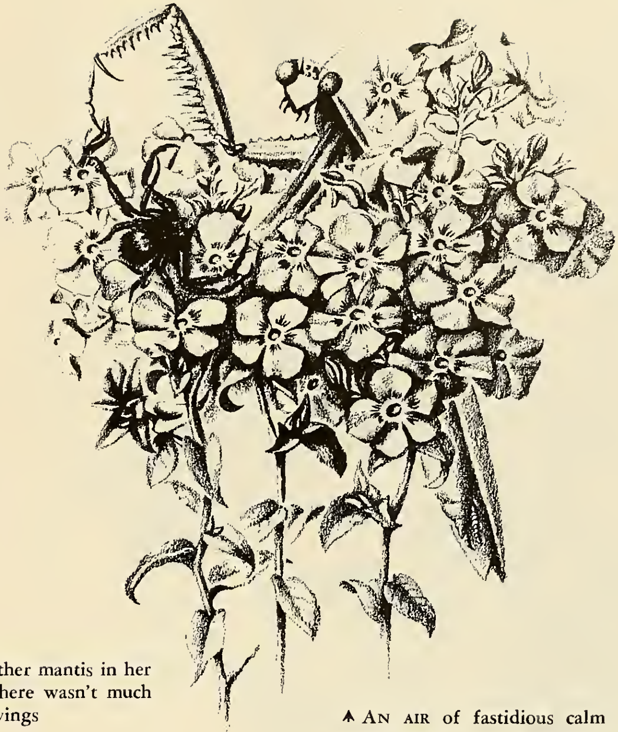
able to turn its head, an ability which contributes much to her uncannily knowing look. The two great, dull-colored eyes seem to have no pupils, but down in their depths a small dark dot is dimly visible. Between them, in the forehead, are three well-developed ocelli; one wonders what she perceives with them and if they are functional eyes at all.

Few insects give so much evidence of possessing some power of thought. True, the ant lion automatically casts up his spray of sand to engulf the hapless ant dashing frantically around the walls of his funnel, and the spider at the center of her web rushes forth at the right moment to dispatch her entangled victim. These are simple responses to obvious stimuli. But put a large, lively spider into the jar with your mantis. The spider has been disturbed by your handling and runs around and around, sometimes passing close to the mantis but always going too fast for even her catlike pounce. At first she rears as if to grab it—her normal response to the sight of an insect in motion—but then she makes no further move. She only waits, as though contemptuously, until the spider has settled down to catch its breath. Then, with infinite stealth and deliberation, she sets herself in a favorable position —and snick!—quicker than the eye can follow, she snaps her trap on it.

And one can scarcely deny that she employs a measure of discrimination when she has captured a great digger wasp gliding to the ground with a fat cicada to place in its burrow. There in her trap the mantis has both the furious wasp and the cicada, paralyzed by the wasp's sting. She considers her catch, turning her head this way and that. Then she grasps the wasp firmly and proceeds to eat it, letting the doped cicada drop to the ground, where she will retrieve it once the wasp is consumed. She shows no hesitation, no uncertainty. To all appearances, she deliberates and reaches the right conclusion. But who can say where instinctive behavior ends and thought begins?

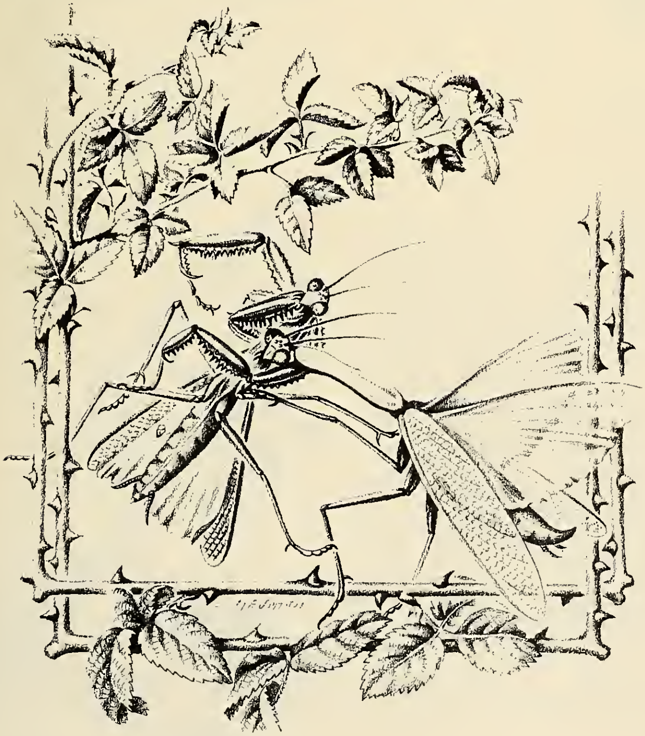
Then there is her reaction to toads. Books tell us that some tropical mantises devour small toads and even small birds. The Chinese mantis in the eastern United States does not eat toads, but her reaction to them is interesting. The Brooklyn Entomological Society records that once an experimenter offered a very small toad to a very hungry mantis. She seized it but dropped it immediately, and nothing could induce her to touch it again. I had a very large *Paratenodera sinensis* which I kept under a bell jar one summer in New Jersey. I had at the same time a half-grown toad which I sometimes introduced under the jar when I had time to watch and remain ready to effect a rescue if necessary. At least once each evening, and often two or three times, the mantis would, after long deliberation, swoop down in front of the toad and rear up, with underwings fully displayed, in what Fabre calls her "spectral" attitude. But having gone that far, her appetite for toad seemed to fail, and she never actually touched him. Possibly the toad's nervous reaction to the shock of her swoop elicited some mantis-repellant effluvium imperceptible to our gross sense. At any rate, she always checked herself on the very point of grabbing him. In the course of the summer the toad became quite blasé about it all, and although unable to keep from wincing a trifle, he would then sit motionless with drooped lids and a look of "Oh yeah?" on his toadish features. It is impossible to know whether the mantis uses some obscure reasoning power or whether she is controlled entirely by instinct.

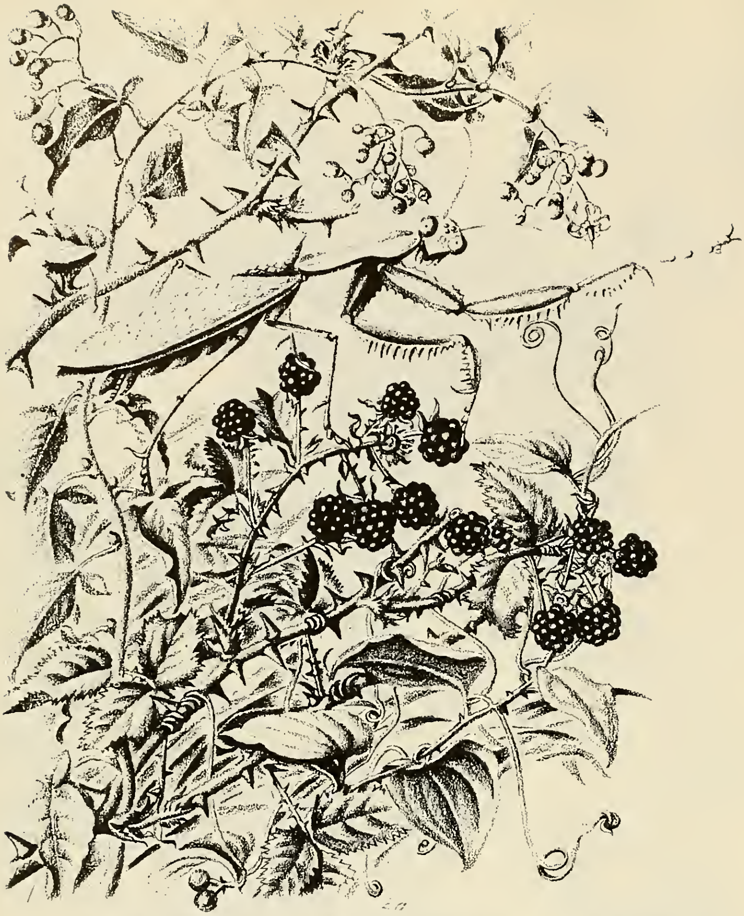
But whether motivated by instinct or by the rudiments of reason, the behavior of the full-grown female mantis shows more variation and originality than is observable in the behavior of many other insects. Each mantis has her own marked individuality. Some are nervous and high-strung, quick to strike at any sudden motion. Some are so deliberate that it is hard to believe that they do not exercise judgment and weigh a choice of courses. Some make most interestin pets, because they will drink milk or water from a small dish or teaspoon, take bits of raw meat from the fingers, or sit companionably on the worktable, staring curiously at fingers or pen as you write, quite as if they were trying to comprehend. Others are always "stand-offish"; they will have none of you or your offerings and will starve to death rather than try an unaccustomed food. Some, having seized a prey, seem to know that a bite in the cervical ganglion will end the victim's struggles, and they put this knowledge to good use; but others, no less powerful and active, never acquire this precision of technique but catch the prey as they can and hold fast with the serrated arm, so that the captive continues his struggles until he is almost consumed. Some make a practice of biting off the head first. Others always start the meal by pulling off a leg and holding it up in a gloating manner, gazing at it with the head turning this way and that before eating it, while



▲ AN AIR of fastidious calm lent greater horror to her murderous actions

▼ MADAME MANTIS was clasping another mantis in her spiny arms—a sister, so it seemed. There wasn't much left except its horny legs and gauzy wings





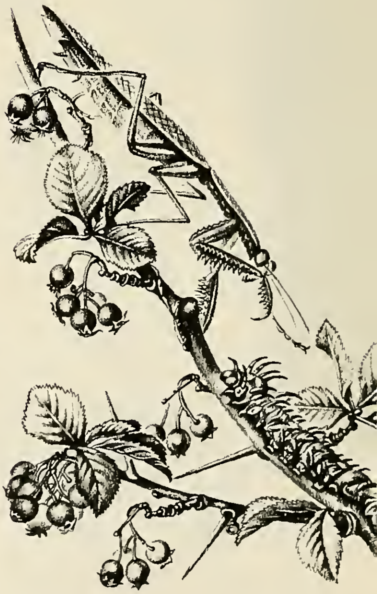
➤ THE ANGULAR GAIT of the mantis reminds one of a slow-motion film, until prey can be captured. Then, a catlike pounce. But remember, the mantis is entirely beneficial to man

some sybaritic mantises will accept neither legs nor wings, thorax nor head, but plunge the triangular beak into the abdomen and lick out all the soft inner parts. These fussy females often leave the victim's outer parts almost intact, so that only by turning the body on its back can you see that nothing is left but a hollow shell, complete with legs and wings. This type is the hardest to provide for. Apparently the abdominal contents are less sustaining than the more muscular portions, and so the insect gourmet drains grasshoppers, crickets, cicadas, and so forth so rapidly that it takes much hunting to provision her larder.

The differences in behavior are paralleled by differences in the externals of nest-building. No two "nests," or egg cases, are exactly alike. This variation results not from whimsy but largely from sheer chance. The shape and size of the twig chosen to support the egg case, interruptions during the long business of nest-making and egg-laying, and possibly even the presence or absence of a breeze at the crucial time may serve to cause slight irregularities in the outer shape of the nest. Certain nests are as fancifully draped and swathed as a Moslem's turban; others are so nearly flat on top and bottom and so short as to make you think that a pat on each of four sides would reshape them into cubes. Occasionally a very small egg case occurs among large ones; it is made by a female that has already produced one or even two larger nests with their complement of eggs.

During its creation and for a very short time thereafter, the nest is almost pure white, very light, and frothy; but it starts to harden and darken in a few moments and stands all winter as an inconspicuous, dirty, sand-colored lump, hard to notice among the weeds and twigs. The mantises seem to regard certain trees and shrubs as especially well-suited to nest-building. Sometimes you may search for hours on a hillside without finding more than one or two nests and then suddenly discover a sapling bearing as many as 30 cases. Is it favorable location that determines the choice, or is it some quality of sturdiness or durability in the chosen twig?

Much remains to be learned about the mantis. Her increasing numbers and the fascination of observing her ways should tempt someone, perhaps now a mere Cub Scout learning first lessons in woodcraft, to make a full-time study of this one insect that is entirely beneficial to man.



➤ MANTISES even devour large spiny or hairy caterpillars

AUSTRALIA'S STINGING TREES

Continued from page 126

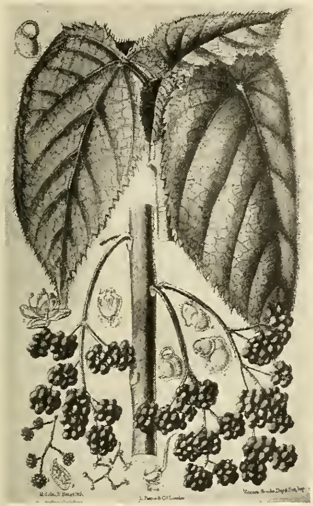


Photo courtesy New York Botanical Gardens

▲ CONTACT with a single hair on the leaf can cause severe pain to spread throughout a large portion of the body. *Laportea moroides*

tree, called the shining-leaved stinging tree, *Laportea photiniphylla*, grows to a height of about 60 feet. Its leaves are less nearly heart-shaped. It is found from Brisbane to Rockhampton and may be somewhat scarcer than the first. I never saw one.

The third species, more a shrub than a tree, possesses most virulent stinging hairs. Moreover, it is the more dangerous from the fact that it grows up along abandoned lumber tracks, reaching over the track from the side so that it is most difficult to avoid. This is *Laportea moroides*, or the "mulberry-like" *Laportea*, which derives its name from the reddish-purple fruits. Its leaves vary from three to eight inches in length. This venomous plant was very common in the tropical rain forests of northern Queensland. When we planned to use the old trails for hunting or for setting trap lines, our habit was first to go through them with bush knives and cut away every single stinging shrub, large or small. Even that operation required care and vigilance, as the cut stems were likely to fall upon the hand holding the knife, with dire results.

Like many other countries, Australia possesses a quota of additional harmful plants, including some deadly ones, sometimes accidentally eaten by stock. Aside from such inedible vegetation, I know of none so intensely objectionable as the stinging trees.

SOS FOR AFRICAN WILDLIFE

Continued from page 111

agriculture and husbandry and the consequent slaughter of the game, there have been attempts to set aside parks for the wildlife. South Africa's Kruger National Park, where game is now suffering from overstocking and a severe drought, is of course the most famous. Umfolozi Reserve has already been mentioned, and in Natal there is a second refuge called the Hluhluwe Reserve. Southern Rhodesia maintains a reserve of sorts at Wankie, way over in the western corner of the country. But in the once faunal-rich regions of British East Africa, parks are at a premium.

Perhaps best known is the 40-square-mile park within four miles of Nairobi, where even the casual tourist can motor out from town in about 20 minutes and see picturesque African animals. The park contains a wide variety of animals, including at least a score of big game species. The large Northern and Southern Game Reserves in Kenya have been in existence for a number of years and are very important, but at present there are no national parks in Kenya, in the true sense of the word.

In Tanganyika the famous 908 square-mile Serengeti Reserve was set up in what Caldwell calls "the greatest faunal area in the world," but thus far it is a park in name only. Tanganyika also has the Selous Reserve and various other game reserves, but they are not adequately administered. Northern Rhodesia has vague plans to someday create a national park and is far and away the most enlightened of the British colonies in the matter of game protection, management, control, and perpetuation. Uganda has no national park and no plans for one. The Congo, of course, has some very famous parks and reserves.

There are several organizations concerned with protection of African wildlife, among them the Wild Life Protection Society of South Africa and the Society for the Preservation of the Fauna of the Empire at London, but they are neither financed nor officered and manned for the battle they must fight. In this country, the American Committee for International Wild Life Protection is doing what it can in the problem and has published a number of bulletins.*

I cannot see the problem as a purely British one. Destruction of the unique and magnificent life of Africa would be a global tragedy, and like so many other world problems, it needs a global solution. Obviously, the tsetse fly must be destroyed or men and animals must be made immune to the diseases it carries. It is also obvious that the wild animals in much of Africa stand in the way of settlement of the country. Both problems must be faced. One way to solve them is to continue planned game extermination. Another is to leave the game to the unplanned fate of the American bison.

Vilhjalmur Stefansson might suggest that, since Africa abounds with animals that have already solved the problem of the tsetse by acquiring immunity to nagana, new animals should be selected from among them and domesticated, rather than to warp Africa's ecology to fit alien animals from other lands. But aside from this untried solution, it seems to me that two things should be done:

(1) More extensive parks and game reserves should be established, and, even more important, funds should be made available for the adequate staffing and patrolling of these reserves so that they may

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* Readers wishing to obtain further information concerning organizations working for conservation in Africa may address their inquiry to Richard Pough, Curator of Conservation and Use of Natural Resources, the American Museum of Natural History.—ED.

become the refuges they are intended to be. Native hunting should be more closely controlled and efforts should be made to cut down the tremendous toll in fatally wounded animals that the hunter cannot, or does not, retrieve. If for no other reason, game should be perpetuated as an invaluable source of meat for people living on little else. Professional hunters and sportsmen should be closely controlled by game experts.

(2) Far more funds and scientists should be made available for research on tsetse fly, the diseases it carries, methods of eradication of the insect, and possible immunization of animals and men against nagana and sleeping sickness.

That will be a costly and perhaps a prolonged program. But game extermination would also be a prolonged and costly process. The diseases carried by the tsetse have plagued Africa since the dawn of time, and their cost in suffering and in retarding the economic development of the country have been incalculable. Whatever must now be spent, whether it be spent by Britain, contributed by private parties, or allotted by UNESCO or some other international organization, it would represent for future generations a cultural benefit and an economic saving beyond imagination.

BOOKS

Continued from page 103

who has thrilled at the sights and sounds and odors in the outdoor world.

John R. Saunders.

ANT HILL ODYSSEY

- - - - - - by William M. Mann

Boston: Atlantic-Little Brown, $3.50

AMONG the most difficult problems one can have is to review a book by someone whose company he has enjoyed over a long period of time. One has the feeling that he might discover that the author does not write as well as he talks. Bill Mann has demonstrated in this autobiography of the early part of his life that any such fears are wholly ungrounded. He writes about interesting subjects with such keen understanding that one lives with him and meets the people about whom he is writing.

In this book we grow up with a naturalist and travel with him to various parts of the world. We enjoy all the excitement accompanying the many discoveries of a great scientist in the making: the boyhood ambitions and indiscretions, the thrill of finding things not known to science, the almost reverent feeling that Mann had because he was able to work with men who had won greatness in the field of science. Bill Mann professes to be an entomologist, but he has always been more than that. To be sure, his chief interest has been insects, and particularly ants, but his great love of all animals has had a happy influence on his whole life, as one gathers in *Ant Hill Odyssey*.

Bill differed from most kids—he not only wanted to run away from home: he did it. This early adventure was a tame prelude to what was to follow in later years, when he wandered over the face of the earth on various missions of discovery. A most interesting feature of the book is that it covers only that part of his life when the author was obtaining his academic education. The story ends when William M. Mann obtains his first regular job with the Bureau of Entomology, at what he calls the incredible salary of $1800 a year. We hope that a later volume will tell of his later explorations and record the events leading to his appointment as Director of the National Zoo.

C. H. Curran.

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Do Not Miss

The Man Who Stole a Shooting Star

The story of the famous Willamette Meteorite, which many readers have seen in the Hayden Planetarium: an absorbing article by Paul M. Sears soon to appear in Natural History.

THE FLIGHT OF BIRDS

- - - - - - - - by John H. Storer

Cranbrook Inst. of Science, Bloomfield Hills, Mich., $2.50

94 pp., 176 illusts.

JOHN H. STORER is well known for his superb slow-motion films of flying birds. With the assistance of foremost experts in the fields of aircraft design, gliding, and ornithology, he now has written this important and thorough analysis of bird flight. The principles of aerodynamics are first explained briefly with the aid of drawings and photographs based largely upon wind tunnel experiments. The structure of the feather and of the bird's wing are next described. In the airplane the lifting wing and the propeller are separate entities, whereas in the bird, lifting surfaces are provided by the tail and by the inner part of the wings, while the outer or hand portion of the wings furnishes most of the propulsion. When soaring, however, a bird may rely upon air currents for propulsion and use its entire wing surfaces for lifting. At the other extreme, the wings of a hummingbird function almost entirely as propellers, attached to the body by swivel-like joints at the shoulders.

Guided by these basic principles, various phases and types of bird flight are interpreted with the aid of carefully selected sequences from the author's films. When necessary, F. L. Jaques has provided sketches to depict more clearly the position of the flight feathers. Most readers will acquire a new understanding of bird flight from this book and at the same time be made aware of unsolved problems such as the difference in the design of the wing in soaring birds of the ocean and of the land. It thus should achieve the dual goal of providing sound information about the flight of birds and of stimulating further observation and research.

Dean Amadon.

Winners of the Wild Mammal Cryptomaze in the January issue of Natural History: The three contestants submitting the highest number of mammals listed in the main section (A-Z) of *Webster's New International Dictionary*—1948 (unabridged), in accordance with the rules of the contest, are: Dr. Henry S. Rich, Bronx, N. Y.—32 mammals; Peter F. Bellinger, New Haven, Conn.—31 mammals; Richard G. Beidleman, Fort Collins, Colo.—31 mammals. Each of these winners has received a copy of *Wild Animals of the World*, illustrated by Mary Baker and written by William Bridges, published by Garden City Publishing Company.

Mammals both above and below the line in the main section (A-Z) were counted, but variant spellings of the same name and words from other sources were not. It is not in the rules of the contest to jump up and down on the same square to form a double letter. Where any of the aforementioned irregularities occurred, the contestant was not disqualified, but he was not given credit for the mammal.

Natural History
CRYPTOMAZE

SEED PLANTS *By* EDWARD DEMBITZ

Part I. In this puzzle you are given a set of definitions, each with a set of blank spaces, and a diagram to be filled in. Each definition is a clue to a word whose letters you are to insert in the blank spaces preceding the definition. These words appear in recent issues of NATURAL HISTORY Magazine.

20 9 18 9 1 15 3	*Southwestern Indians whose language was used as a code in World War II*
12 8 13 19 20 11 2 15 20	*American painter (1861-1909), best-known for Western scenes and drawings of horses*
16 7 14 22 14 15 11	*Lighted on Christmas Eve, it once served in heathen sunshine-making festivals (2 words)*
1 17 4 5 3 20 19 23 8	*Long-billed shore bird whose wing vibration while diving produces a "song"*
5 9 14 9 6 17 12 19	*Large South African desert, home of the Bushmen*
12 17 13 19 25	*Asiatic plant whose fibers were used by the Egyptians in wrapping mummies*
17 12 4 6 10 15 14 24	*Biological station in Florida, named for an American Museum Research Associate*
22 7 4 9 14 16 23 2 19	*Common Australian trees whose leaves form the exclusive diet of the koala*
13 19 14 5 21 22 22 24	*Plant that traps pollen-bearing insects in its flowers*
15 12 10 21 22 17 18 25 12	*Spider that spins a circular web of radiating and spiral threads (2 words)*

Part II. When you have filled in all the letters above, transfer them to the proper numbers in the boxes in the diagram below.

When the diagram is completed, you will have a word maze containing at least 36 names of SEED PLANTS (flowers, trees, shrubs, vegetables, herbs, etc.). To find one of these plants, begin with a letter and move from space to adjoining space in any direction, including diagonally, until the name is spelled out. You are not permitted to form double letters by jumping up and down on the same square.

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

Copyright 1949
By Edward Dembitz

THREE PRIZES. *The three contestants submitting the largest number of names of plants fitting this puzzle will each receive a copy of* THE WILD FLOWER GUIDE, *by Edgar T. Wherry, recently published by Doubleday and Company.*

Names of plants must appear in bold-faced type in the main A-Z section of Webster's New International Dictionary—1948 (unabridged) in order to be eligible. Names in bold-faced type below the line at the bottom of the page are allowable. Different names for the same flower, tree, shrub, vegetable, or herb will be accepted. But scientific or technical names will not be counted unless they are in bold-faced type.

In case of ties, duplicate prizes will be awarded.

Entries must be postmarked on or before April 1 and be received by April 6, 1949.

Winners and their scores will be published in NATURAL HISTORY *for May, 1949.*

The contest is open to everyone except employees of the American Museum and of Doubleday and Company, and their families.

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THE DEVIL'S SLIDE

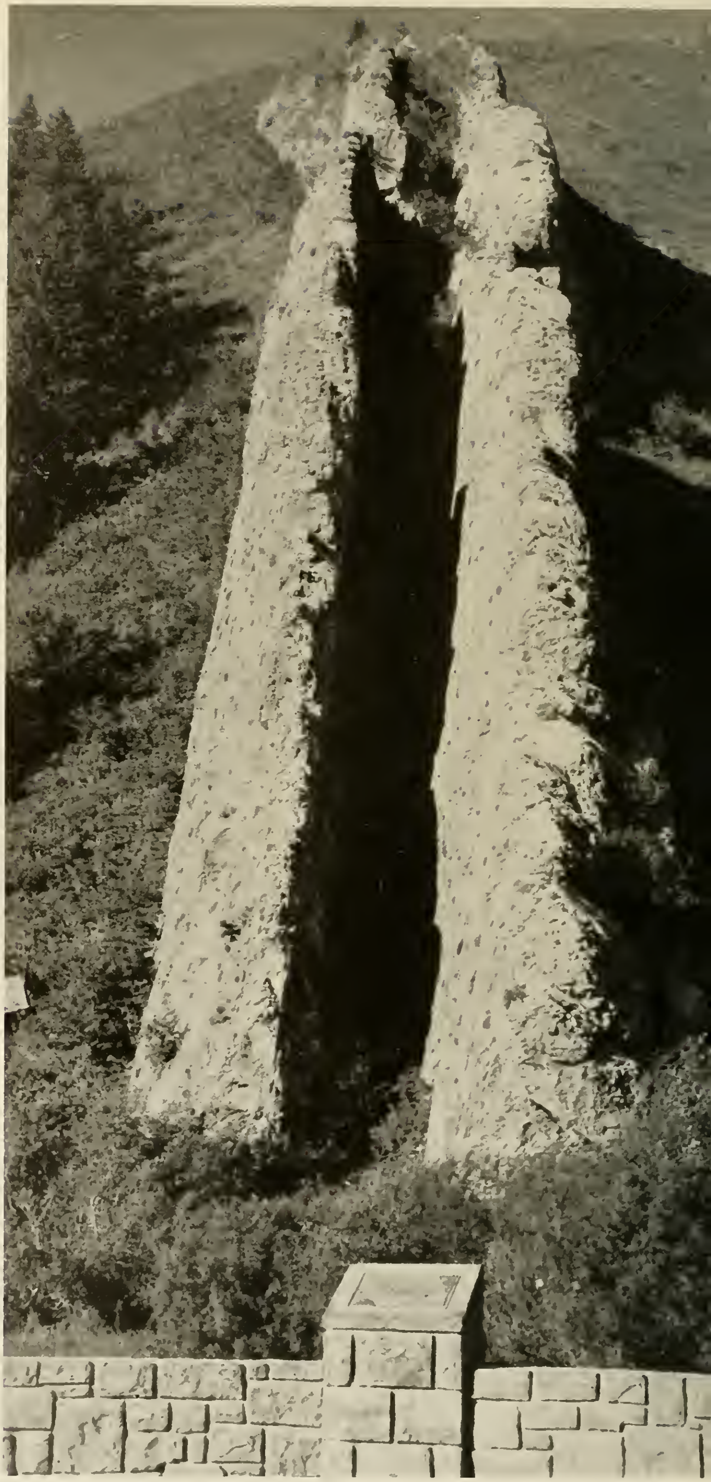
BY
VERA and HENRY BRADSHAW

MOTHER Nature, in addition to creating things of great beauty, has produced a number of freaks. One of these outlandish, awe-inspiring displays is "Devil's Slide" in historic Weber Canyon, Utah.

It is two gigantic horizontal pieces of rock extending down a steep hillside, and so closely does it resemble a chute-the-chutes that, at first, one wonders if it were not built by human hands. Geologists say no, that the queer formation came about in a prehistoric age and happened something like this:

The rock layers had been created in the earth over a hundred million years when along came a violent compressive force which folded and upheaved them.

Many years after this, the simulated slide was formed because a layer of shale, tucked between the two more durable limestone layers, eventually wore away and disappeared. Thus, the two protruding sturdy limestone sides were left to form the famous "Devil's Slide."

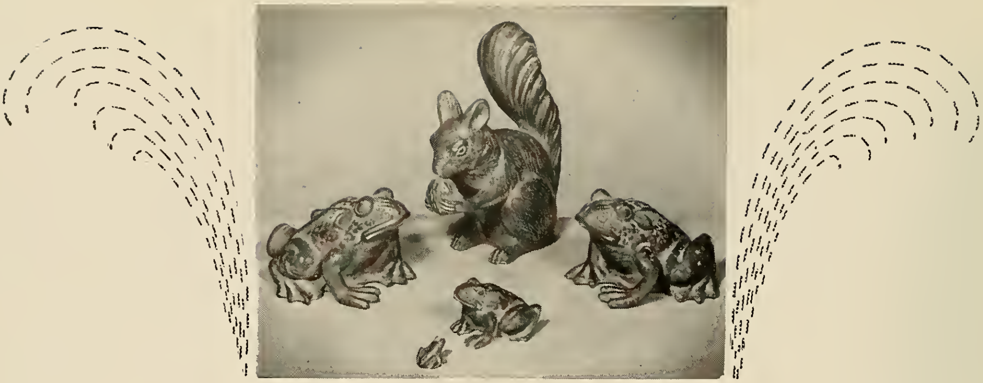


➤ A STRANGE PHYSIOGRAPHIC FORMATION that almost looks as though it had been built by man: the Devil's Slide in Utah

April **NATURAL HISTORY** *1949*

Among The Turkana • Our Inland Seas • Honey Hunting

Discovering New Zealand • The Albatross • Bean Beetle



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LETTERS

"Nature's Little Tank" in Florida

SIRS:

Recalling Karl H. Maslowski's article on the armadillo in the October, 1948, NATURAL HISTORY, I offer the following observations on this animal in Florida.

I have lived in Daytona Beach my entire lifetime (50 years). About the year 1930, for the first time, there appeared on the mainland of our county a few little creatures that, after some study and inquiry, were catalogued as armadillos. It was, and continues to be, a matter of conjecture as to how these little fellows found their way to the eastern shore of Florida, approximately 100 miles south of the mainland of the United States on the Florida peninsula. Your readers will recall that the armadillo's movement northward from Mexico during the past 100 years has not progressed nearly as far eastward as Florida.

For a number of years, these little fellows continued to inhabit the mainland of our county. While it was not a common sight to see them, they nevertheless gradually grew in numbers, and about 1940 they began to appear on the island created by the Halifax River. This island is about 3 miles wide and some 60 miles long. The river, if such it may be called, begins and ends in the Atlantic Ocean and is about a mile in width.

The island, as well as the mainland, is, generally speaking, high and sandy, with a growth of wild palmettos and large numbers of citrus groves and vegetable gardens. The armadillos seem to have thrived and have now reached a population equal to that of the other small animals of our countryside, such as rabbits, squirrels, etc. As an example, when I was taking an early morning trip from Daytona Beach to Ormond, a distance of seven miles on the island referred to, I saw eight armadillos scampering across the highway. They do not yet cause extensive damage, but some of the people engaged in cultivation have been troubled by them and are beginning to voice concern.

A FLOATING AIRDROME. A camera study by Dr. Lorus J. Milne, heralding the return of warmer summer days

This information may be interesting for the record, and possibly you may be able to give further facts concerning the story of the armadillo in Florida.

RAY SELDEN.

Daytona Beach, Fla.

The following comments are offered by T. Donald Carter of the American Museum's Department of Mammals:

There are records of armadillos in Florida as far back as 1922, when one was taken near Miami. It was then discovered that at the end of the first World War, a Marine had liberated a pair close to where this animal was taken. He had brought the original pair from Texas. Later, about 1924, some armadillos escaped from the Cocoa Zoo in Brevard County. These animals also originally came from Texas. Soon they were becoming quite common in that region.

About ten years ago, a friend of mine reported that an armadillo was spending much of its time under her house in Rockledge. And three years ago, an acquaintance who lives just north of Rockledge told me that the armadillo had become a common animal in that district and had only lately crossed the bridge over to Merritt's Island.

The armadillos around Daytona Beach undoubtedly are descendants of the Cocoa animals which have moved farther north. It is very possible that armadillos have

"Wonder House,"

a Film Portraying the American Museum

The attention of readers is called to a new motion picture entitled "Wonder House," which tells the story of the American Museum of Natural History. It is one of the *This Is America* Series, produced by RKO-Pathé News, and will be released soon after April 1. Persons interested in seeing this unusual picture should ask the manager of their local theater when it will be shown.

▲ BÊTE NOIRE: a Wolf Spider of the family Lycosidae. Two of its four large eyes are visible, as well as the four smaller ones. Photographed by Henry B. Kane

been introduced elsewhere in eastern Florida without our knowledge. I feel fairly confident that the armadillo did not find its way to the east coast of Florida without human aid, although the eastern movement from Texas seems to continue. The animals have successfully crossed the Mississippi River and have established themselves in both Mississippi and, more lately, in Alabama.

Do Eskimos Rub Noses?

SIRS:

Do Eskimos really show affection by rubbing noses, or is this only an idea that has grown up?

JOHN ROSHEK, JR.

Dubuque, Ia.

Yes, Eskimos do show affection by rubbing noses but not quite in the way that many people have come to believe. Almost always the gesture is used by a parent toward a small child, especially after a long absence, or between children. The custom has been observed widely in the Eskimo region, from St. Lawrence Island in Bering Sea to East Greenland.

A man and a woman do not ordinarily rub noses. However, it was reported some years ago that a bride and groom in East Greenland customarily kissed each other by rubbing noses.

A curious game has been reported among the Eskimos of King William Land, in which the winner goes around a whole row of women, placing his arms around their necks and nuzzling violently at their noses. As the game progresses, the wholesale nose-rubbing may cause the noses of some of the women to bleed.

From Alaska, we have occasional mention of nose-rubbing as a greeting for strangers in earlier times. In 1826, when the explorer Beechey visited St. Lawrence Island, the Eskimos rubbed their noses against his and further expressed their welcome by rubbing the palms of their hands over his face.

Kissing as we know it seems to have been quite unknown among the Eskimos before the coming of white men.—ED.

* * *

SIRS:

. . . Being especially interested in the study of ancient man, I find the articles you have published on the later discoveries along this line in South Africa very interesting and highly educational. There seems to be an unlimited field ahead for such work, and many more discoveries may, of course, be made in the next few years. Let us also hope that more interest will be shown here in America in unearthing further evidence of Folsom Man.

I am very grateful to you for these many wonderful items of interest and am looking forward to more articles of this sort in NATURAL HISTORY. With best wishes for your future success, I remain

L. B. SIMONS.

Laton, Calif.

Animals in Silver

An unusual exhibit entitled "Shining Birds and Silver Beasts" will remain on display in the 77th Street Foyer of the American Museum through April 15. The exhibit shows the work of Paul A. Lobel, who has made a specialty of stylized portrayals of animals in sterling silver.

Eclipses in the Planetarium

Eclipses of the sun and moon have been charged with mystery and wonder since before the dawn of history. Their strange beauty has attracted the attention of people in all ages. While much of the mystery is gone from these phenomena today, they are still of great interest to the astronomer and hold a weird fascination for the layman.

Visitors to the Hayden Planetarium during April will enjoy the splendors of lunar and solar eclipses beneath an unclouded sky. With time condensed and the heavens under complete control, the lecturer will explain many of the strange and interesting facts associated with celestial blackouts. He will be aided by the use of a special eclipse projector, which will clearly demonstrate the mechanics behind the phenomena. The audience will look into yesterday and enjoy some of the memorable eclipses of the past, to learn how they changed the course of history.

April 12 is the date of the first of two total lunar eclipses occurring this year. On April 28, there will be a partial eclipse of the sun.

CONSERVATION

The Legislative Front

HEARINGS are now under way in the House of Representatives on the budgets for the various government departments, and this is the time for conservationists to let themselves be heard.

Although Congress authorized $500,000 last year for the purchase of lands within the Superior National Forest, to save the wilderness character of this area from destruction by resort developments, there is only $100,000 for this purpose in the current Forest Service budget. This is no time to temporize with the very serious threats that exist to the whole future of the Quetico-Superior wilderness project. The budget should be amended to make the full amount of the authorization available at once to the Forest Service. Also, this is the time to insist that provision be made for an intelligent and co-ordinated management of the wildlife of our National Forests. A start in this direction can be accomplished by restoring to the budget the item of $165,000 for a Division of Wildlife Management within the Forest Service, which was dropped several years ago as an economy move.

For years Congress has failed to meet

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NATURAL HISTORY

The Magazine of the American Museum of Natural History

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VOLUME LVIII—No. 4
APRIL, 1949

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THE COVER THIS MONTH

These gorgeous yellow flowers, which are sometimes four inches or more in diameter, adorn the spectacular and peculiarly shaped tree known scientifically as *Cochlospermum* (or *Maximiliana*) *vitafolia.* It is particularly distinctive because when all other plants and trees are dying, it bursts into full bloom, and its beauty lends a golden life to a dying landscape.

Its numerous seeds are clothed with a silky down. The tree grows in rather dry areas in Cuba and follows the Pacific coast of Mexico to northern Colombia, northern Venezuela, and southern Ecuador. It has been planted for ornamental purposes in the Virgin Islands and Puerto Rico, where this color photograph by Alonso Aguilar, Jr., was taken.

You will find Natural History Magazine indexed in *Readers' Guide to Periodical Literature* in your library

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YOUR NEW BOOKS

ASTRONOMY • HOW TO KNOW BIRDS • AZALEAS
AUSTRALIAN WILD FLOWERS • CUCKOOS

HOW TO KNOW THE BIRDS

An Introduction to Bird Recognition

- - - - - by Roger Tory Peterson

Houghton Mifflin Co., Boston, $2.00
144 pp., 4 colored plates, numerous drawings by the author

PETERSON'S well-known eastern and western field guides have done more to promote the hobby of bird study than any other publications of recent years. Nevertheless, the mere beginner who consults them to find the name of some bird he has seen is often bewildered by the hundreds of kinds of birds confronting him. The present little volume is intended to give such individuals an introduction to the methods of field identification. The importance of placing a bird in its correct family before proceeding further is emphasized. As the author remarks, no experienced birder compares a reddish duck with a reddish sparrow. He first determines whether a bird is a duck, a sparrow, or a member of some other group by careful observation of its actions, call notes, general appearance, and preferred habitat. To aid in doing this, various habitats are described and the birds to be expected in each are enumerated. Bird silhouettes are used to emphasize the importance of outline and posture in identification.

To permit application of the above principles the families of birds of eastern North America are briefly reviewed. The better known species each receive a few words of comment and are figured. In the more difficult or numerous groups only the plumages of the adult males are considered. This book should enable anyone to identify many of our more conspicuous birds and while doing so to become qualified to tackle more difficult species with the aid of the *Field Guide* or other manuals. Although intended primarily for beginners, *How to Know the Birds* will be valued by many others because of the numerous illustrations and the fund of general information scattered through its pages.

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AN AUSTRALIAN WILD FLOWER BOOK

- - - - - - - by Charles Barrett

Geoffrey Cumberlege,
Oxford University Press, Leighton House,
Melbourne, $3.00
205 pp., 47 illusts.

THIS little book is for the rambling reader not necessarily trained in botany. It moves along at a pleasingly fast pace in discussing the wattles, gems of the bush, heathlands, western wild flowers, orchids, alpine gardens, Tasmanian flora, beautiful shrubs, wonder-plants, and ferns—to give you a résumé of all the chapters—and is a "companionable guide to Australia's wild gardens."

All in all, about 13,000 species of flowering plants are native to Australia, about four-fifths of which are restricted to that continent. Here and there are observations as to how these wild plants do under cultivation and notes about botanical discoveries of the early explorers. The pirate William Dampier made the first botanical collection; and so remarkable was the assemblage of species around a place called Sting-ray Bay that Captain Cook changed its name to the well-known Botany Bay. Among the "wonder plants" are included the pitcher plant (*Cephalotus*), Queensland's upas tree (*Pisonia Brunoniana*) which sometimes catches small birds on the sticky fruit, a subterranean orchid (*Cryptanthemis Slateri*), and the "weird-looking drumstick grasstree" (*Kingia*). For American readers, who are too often fed upon cut-and-dried literary vegetation and care little "for text-book botany, yet desire to know more than the popular names of plants seen on their rambles, and are interested in little biographies of species," Barrett's book should be an inspiration.

H. K. SVENSON.

THE STARS ARE YOURS

- - - - - - by James S. Pickering

The Macmillan Co., $3.95
264 pp., 23 photos

IN *The Stars Are Yours*, James S. Pickering presents a simplified approach to astronomy. No higher mathematics is used, and involved scientific explanations are omitted. He begins with objects that may be seen with the unaided eye and points out that from this standpoint "there aren't so many different kinds of things to be seen in the heavens." Perhaps from a beginner's standpoint this is true, and most certainly this book is written for a beginner.

The solar system is first discussed starting with the sun. Each planet is then taken up in the order of the distance of its orbit from this central body, with the asteroid belt and the satellites of each body introduced in their proper places. The author misses few opportunities to bring in interesting discoveries, such as that of Olaus Roemer relating to the speed of light. Roemer observed the occultations of one of Jupiter's satellites and "noticed a peculiar discrepancy in the length of time it took the same moon to make the passage across the far side of Jupiter." The author concludes his brief discussion of the solar system with a discussion of the orbits and motions of the planets, comets, and meteors. The transition from this system to the stars in the regions beyond is accomplished by a series of excellent reproductions of photographs taken by some of the leading observatories.

The next step is logically the stars. These are introduced with their system of designation and magnitude. After a short briefing in the meaning of such things as stellar distance, size, mass, star motions, spectroscopy, and the telescope, the matter of star charts and constellations is discussed and illustrated at great length and in some detail. Appended are useful tables, lists and names of stars, and a brief discussion of the southern sky. Quite a few errors appear in the text.

GORDON A. ATWATER.

A New Theory of
HUMAN EVOLUTION
By SIR ARTHUR KEITH

EVER since man's kinship with the apes was recognized, there has been controversy over the nature and habitat of his pre-human ancestors and the causes which led to their evolution into *homo sapiens*. Now Sir Arthur Keith, in a book finished, as he tells us, on his eighty-first birthday, gives us the results of his years' study of these questions. $4.75

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A HANDBOOK OF THE BIRDS OF WESTERN AUSTRALIA

- - - - - by D. L. Serventy and H. M. Whittell

Paterson Press Ltd., Perth, Western Australia, 15 shillings
365 pp., 32 figs., 2 color plates

FEW readers of NATURAL HISTORY will ever be fortunate enough to travel to Australia. But even the others, so far as they are bird minded, will be interested in this very competent and practical handbook of Western Australian birds. It is the first thoroughly up-to-date Australian bird book. Though each species is adequately described, with due consideration to the diagnostic field characters, the emphasis throughout is on the bird's biology. In fact, it contains a convenient summary of the most recent literature on the life histories of Australian birds. The conservationist will find much of interest in this volume. On the ground that it kills lambs, bonuses on 94,090 heads of the magnificent Wedge-tailed Eagle were paid between 1928 and 1948. 57,034 emus were destroyed in 1935 during a seven-month period. In January, 1946, during a single shoot, no less than 960 ducks were killed, including 40 of the rare Freckled Duck, a bird unrepresented in most museums. The authors' vigorous interest in conservation gives us hope that such excesses will not recur in the future.

The introduction includes a most interesting and readable history of Western Australian ornithology and a section on bird geography. There are two colored plates and 32 figures in black and white (including 9 distribution maps). I can recommend this volume without reservation.

ERNST MAYR.

FLOWERS OF PRAIRIE AND WOODLAND

- - - - - - by Edith S. Clements

H. W. Wilson Company, $2.25
83 pp., 24 color plates

THOUGH the plates have become a bit anemic (due to overprinting, I suspect), this volume is a handy compendium of the color plates that appeared some years ago in the *National Geographic Magazine*. A few, such as the bird's-foot violet, are badly off color, and the pink gerardia (*Gerardia tenuifolia*) is certainly not correctly named. An attempt to show the evolutionary series from Buttercups to Asters gives a complacent version of the subject, about as far or perhaps a little farther than one would wish to go without controversy. But the accompanying notes provide a good deal of information about plant families and the characteristics of individual species portrayed in the plates. The amateur can leaf through this book and by means of the illustrations establish for himself a pretty good foundation for recognizing members of the chief plant families of the temperate region; since the whole area from California to Maine is covered, this applies also to the professional. Refreshing touches appear, such as the name "Spring Lily" for *Erythronium.* There is much information that is interesting and unusual, and at such a reasonable price the book should be accepted in the comprehensive spirit in which it is written.

H. K. SVENSON.

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SWEEPER IN THE SKY

- - - - - - - - by Helen Wright

The Macmillan Co., $4.00
253 pp., 3 illusts.

SWEEPER IN THE SKY by Helen Wright is a biography of Maria Mitchell, whose life span was from 1818 to 1889, a period fraught with the beginnings of Woman finding a place for herself in the world outside of her home.

She was brought up in a strict Quaker home in Nantucket Island, 30 miles from the coast of the mainland, where the great bulk of the United States is referred to as the Continent and where everyone is interested in celestial navigation because the men made their livelihood by sailing the seven seas.

One of the most vivid impressions of her childhood is that of bending over a chronometer, steadily counting for her father the moments preceding an annular eclipse in February, 1831. As the author says, "Maria Mitchell, 12 years old, was never to forget that eclipse—the darkness, the stillness, the dawning sense that she was a part of a great and orderly universe." Very early her father realized that "this child's eyes were unusually sensitive to variations in color and form," a fact that certainly contributed to her amazing success as an astronomer. In 1846, she discovered a comet which made her the first recognized American female astronomer. Many lasting friendships were gained out of this discovery as well as a medal from the Danish king. A trip to Europe followed, on which she met all the great astronomers of the continent.

Besides her work with astronomy, she taught school and served as librarian in the Atheneum, where such people as Emerson, Melville, Lucy Stone, Horace Greeley, and many others came to lecture.

Finally came her work as the head of the Astronomy Department of Vassar. Here she taught her girls to sweep the sky and to gain the companionship of women studying together.

Miss Wright has written a book that should have broad appeal because it is not technical, but it falls short of making Maria Mitchell, herself, a very interesting person. However, her picture of the nineteenth century and of woman's place in it is very graphic and extremely interesting.

GORDON A. ATWATER.

THE PARASITIC CUCKOOS OF AFRICA

- - - - - by Herbert Friedmann

Washington Academy of Sciences, Washington, D. C., $4.50
204 pp., 10 plates

MOST birds give devoted care to eggs and young, but among others the duties of parenthood fall entirely upon one sex. Several small groups of birds even avoid the trouble of incubating their own eggs, depositing them instead in the nests of other species.

The common cuckoo of Europe is famous for this "brood parasitism," of which our own cowbird is another familiar exponent. As a graduate student at Cornell University, Dr. Friedmann made a brilliant study of the cowbird and later traveled in South America and Africa to expand his researches. Africa has no fewer than fourteen parasitic species of cuckoos.

In the present book he supplements his own observations with all the reliable published notes and with information furnished by friends. He discusses and describes all these parasitic cuckoos and in addition gives detailed evidence about more than a hundred other African birds that have been reported as "fosterers" of young cuckoos.

Parasitic cuckoos certainly had ancestors that built nests and reared their own young. In Africa none now shows any intermediate stage in behavior, save that three of the smaller kinds sometimes feed young they did not rear. Careful

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study of unusual cases must throw new light on general problems of bird behavior.

Each species of parasitic cuckoo appears to have a special list of fosterers. The great spotted cuckoo prefers members of the crow and starling families; the didric cuckoo most often victimizes weaverbirds. Of a few sylvan species, almost nothing has yet been learned.

Since ancient times, men have wondered about the strange ways of the European cuckoo, but during the past 40 years much of the mystery has been cleared away. Now we are shown by Dr. Friedmann what an inviting field awaits similar investigation in tropical Africa.

JAMES P. CHAPIN.

DANA'S MINERALS AND HOW TO STUDY THEM

- - by Cornelius S. Hurlbut, Jr.

John Wiley & Sons, $3.90
323 pp., 387 illusts.

SINCE the Yale mineralogy books have been turned over to Harvard for revision, it is not unexpected that the small popular mineral identification work published by E. S. Dana in 1895 should be revised and brought up to date by Dr. Hurlbut, who has already revised the larger *Manual of Mineralogy*. The new edition has attempted to retain some of the atmosphere of the older work, as well as its popular approach. However, the rewriting is extensive and has made the book considerably easier to read; in fact, this edition amounts almost to a new work. There are long sections on the determinative work of mineralogy, the recognition of crystal shapes, the use of the blowpipe, and the methods of performing the other tests. At the end there are determinative tables arranged to eliminate unknowns on the basis of their luster, hardness, color, and gravity. In between we find a selection of common minerals described in greater detail.

The position of this book has always been equivocal, and the revision has not much clarified the situation. Hurlbut is an authority in his field; hence, the facts are correct and often interesting. However, the mineral list is so abbreviated that one wonders about the value of the book. In the *Manual* will be found sufficient instruction on testing and a longer list of minerals. However, one cannot recommend a book when the collection it suggests for a beginner places andalusite in its major group and relegates one of the Mohs' hardness scale minerals, topaz, to a lesser rank. The first nine minerals of the hardness scale are fundamental for any collection. Mr. Dana, in 1895, may have thought himself fortunate to have "a skillful wood-engraver Mr. W. F. Hopson" for some of his illustrations, but they only detract from the modern appearance of this edition. Most collectors pick up hints on how to collect, catalogue, and arrange minerals from their fellows, and they do not need instruction in these aspects. For the absolute beginner with no contacts and no opportunity to see collections made by others, this book will undoubtedly have some value, but for the average person it does not seem to be as useful as Dr. Hurlbut's revision of Dana's *Manual of Mineralogy.*

F. H. POUGH.

AZALEAS, KINDS AND CULTURE

- - - - - - by H. Harold Hume

The Macmillan Co., $3.75
199 pp.

AZALEAS are fascinating plants, and much has been written about them. The latest addition to the literature on this topic is a well-balanced, instructive, and entertaining book that will be of interest to everyone who grows Azaleas or would if he could.

The author describes the various kinds of Azaleas, has something to say on their countries of origin, comments on soil requirements, discusses the need for water, shade, fertilization, et cetera, et cetera. Certain varieties may feature plantings out-of-doors, and others need a greenhouse (if winters are cold) to find their ultimate expression in a floral abundance exceeded by no other group of plants. So extensive is the range of variation found in Azaleas that almost every location that will grow a plant will prove a happy home for certain species of this large group.

This variation covers size of plant and habit of growth, color of flower, permanence of foliage, temperature tolerances, and other less obvious characteristics. Some Azaleas are easily grown; others are difficult. All are beautiful and desirable plants; but, of course, some are better than others. To one familiar only with the spectacular bloomers, the more modest and retiring species may appear as drab as country cousins, but in reality the quiet relatives repay a closer acquaintance.

Azaleas are a challenge to any gardener with the space and means to indulge a plant hobby. Their appeal is immediate, but the hold they may take is insidious. So many beautiful kinds to choose from, such a gratifying response to the proper care, and finally what tragedy when the winter snows depart and one discovers that rabbits, too, like Azaleas.

Mr. Hume, in his book, provides the proper background for the successful study, growth, and appreciation of Azaleas. With its splendid illustrations, the book is enjoyable reading even for those who cannot play in the dirt. And a single reading will not dispose of this book, for it is of a sort frequently used for reference.

H. E. ANTHONY.

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by Victor Wolfgang von Hagen
author of Maya Explorer

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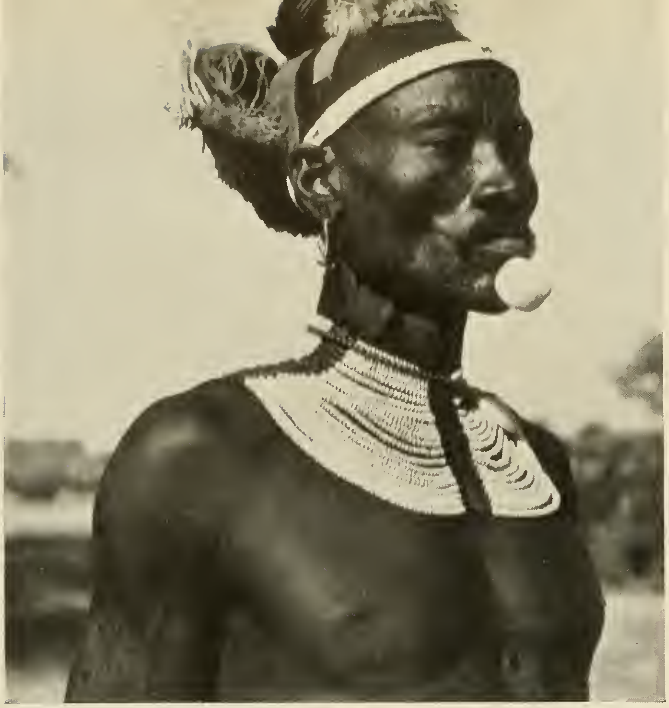
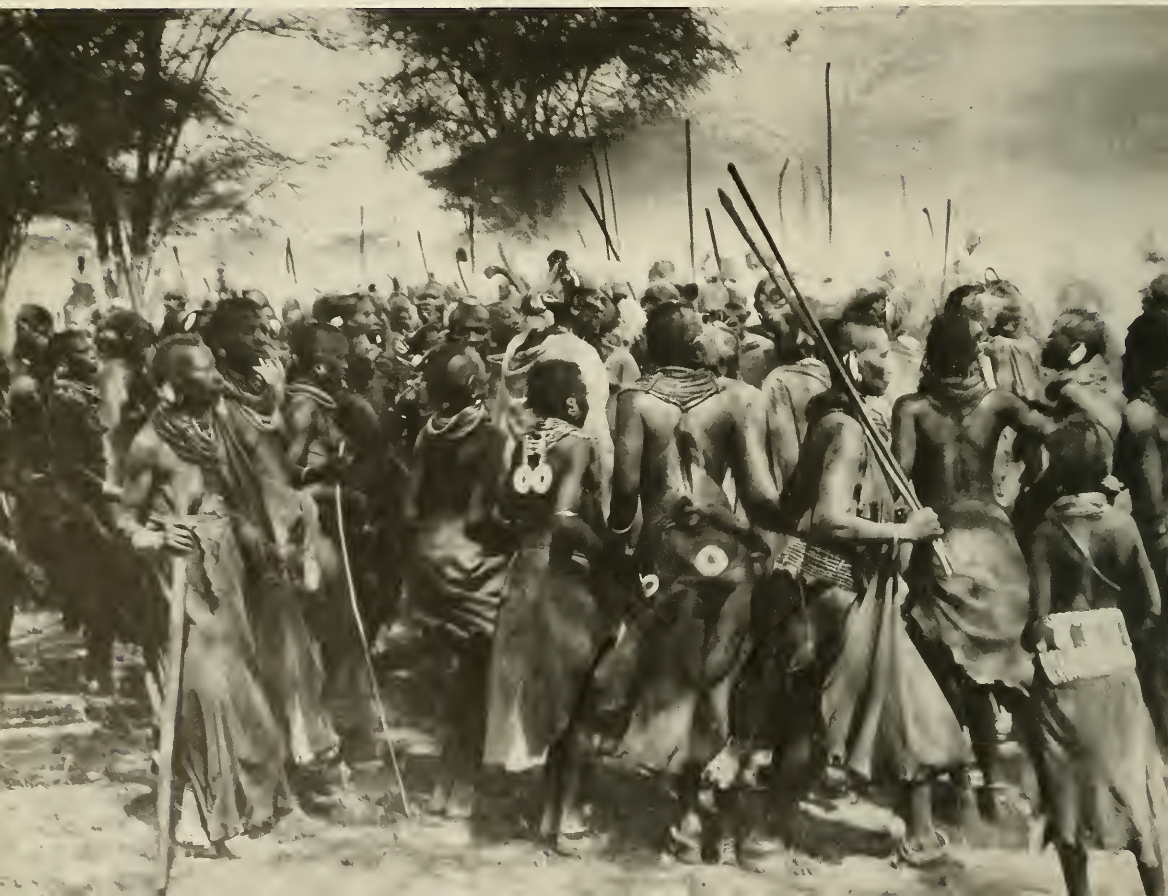


FOR miles the road had grown ever more difficult. Already we had bounced and swayed and jolted almost endlessly over its troublesome irregularities. We had plunged and bumped across any number of "sand luggers," or dry stream beds, but now we had reached what appeared to be the very grandfather of them all—a 300-yard-wide bed of treacherous white sand that shimmered in the oppressive heat and offered a most insecure footing for wheeled vehicles. For part of the way across it, the track had been improved with

◄ A TURKANA POLICEMAN, who proudly sports an ivory lip plug. The Tribal Police are recruited from the Turkana

▼ THE DUST AND NOISE of a lively danc are irresistible to the Turkana. A colorfu performance was enacted for the expeditio by special arrangement



Among the TURKANA

The story of a recent expedition among a tribe that lives in the arid and remote northwestern portion of Kenya Colony in East Africa

By Lt. Col. *and* Mrs. William J. Morden
Leaders of the Morden African Expedition of the American Museum of Natural History

All photographs by Morden African Expedition

THE AMERICAN MUSEUM OF NATURAL HISTORY NEW YORK
MORDEN AFRICAN EXPEDITION

▲ One of the safari cars deep in the sand near Lake Rudolf—an oft-repeated situation in the Turkana country

a kind of corduroy made of the branches of such trees as could be found round about, but we could keep going only as far as the corduroy extended. No sooner had our first car left the uncertain "pavement" of branches than it settled axle deep in the dry sand and refused to budge.

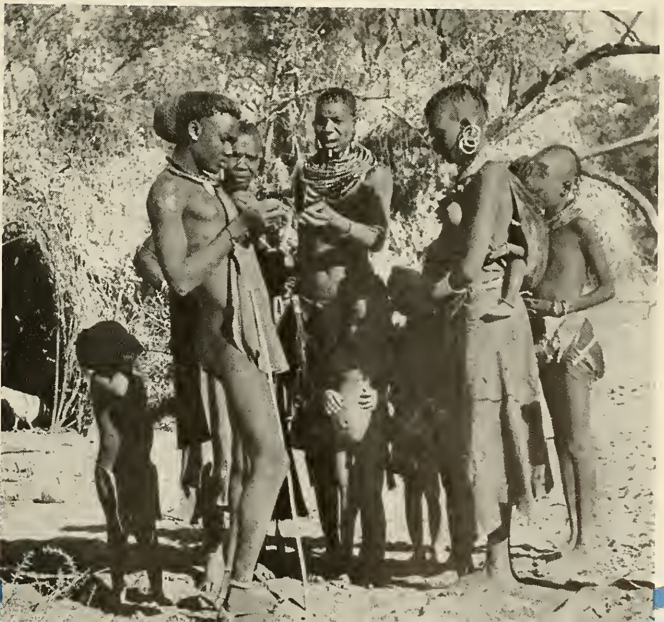
We had arrived in Cape Town from New York two months earlier and since that time had driven north over almost 4000 miles of good, bad, and indifferent African roads. We had motored east and north to Natal and the Orange Free State. We had crossed the Transvaal and Southern Rhodesia. We had visited Victoria Falls and driven the full length of Northern Rhodesia. We had crossed Tanganyika Territory and now, having entered Kenya Colony from the south, had finally reached its arid northwest corner—the bare and remote land of the Turkana, where our expedition's most important work was to be done.

Our party was not small. With us were Kepler Lewis, the expedition's anthropologist, who had accompanied us from New York; a white hunter and a white mechanic, who were in charge of our four motor cars and other safari equipment; and our seventeen native "boys."

And now we had reached the Turkana country. Our road had run through the beautiful Kenya highlands, skirted the slopes of distant Mt. Elgon, and continued down the mighty escarpment of the Rift Valley. Here, with our ultimate destination not so very many miles away, we were crossing a dry region featuring thorny trees, equally thorny bushes, and a curious variety of anthills standing some 20 feet high and peculiar to this region. In fact, this was an especially unattractive place in which to get stuck!

Up to now any casual observer would have assumed that there was no native life whatever within miles of us. We had caught occasional glimpses of a few individuals along the way, but there had been no apparent signs of any for some time. Nevertheless, bare and arid though the country was and deserted though it seemed to be, we were about to have our first important contact with the people we had come so far to see.

Little obscured the nearer view except some groups of acacias and other thorn trees. There seemed to be practically nothing that anyone



➤ This Boringo Suk family was intrigued by bits of American costume jewelry carried by the expedition for trade purposes

▲ TERMITE HILLS like this one lend a touch of fantasy to the arid Turkana landscape. Some were about 20 feet high

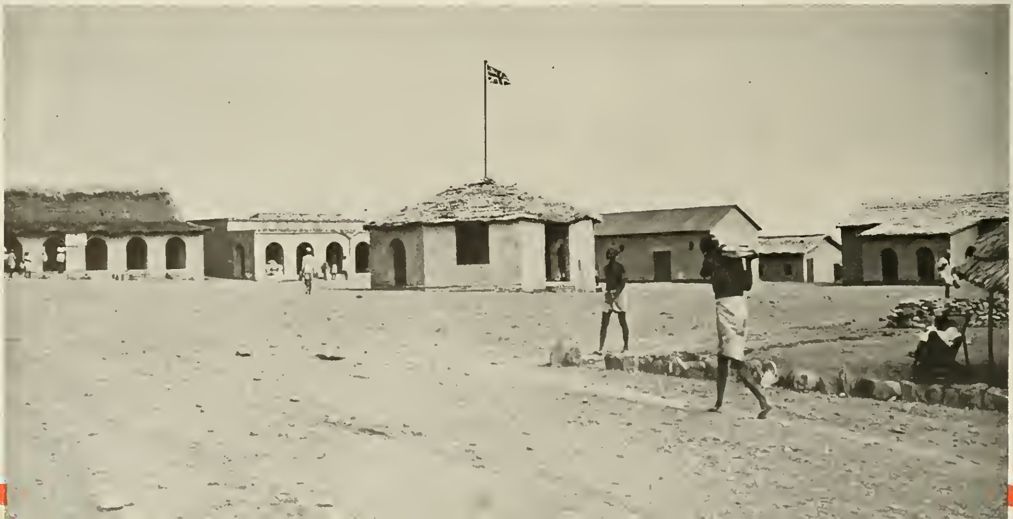
could have been hiding behind. Yet, to our surprise, natives we had failed to see now began to materialize. Where they came from it was hard to say, but in a matter of minutes they began to arrive. For the most part they were utterly naked, though a few wore loose, toga-like robes of brown cloth that were knotted picturesquely on their shoulders. Every one of them had some fantastic headdress. Their hair was heavily daubed with mud and was arranged on the backs of their heads in strange, bunlike masses to which ostrich feathers gave the final decorative touch. Naked though most of them were, they went in strongly for "costume jewelry," and besides leg bands of gazelle hide, they wore necklets of beads and wire, earrings, bracelets, and lip plugs made of ivory or metal. But despite the savage picture they presented, they had all the good nature in the world, and they turned-to with a will to dig us out with their bare hands. One chap actually ran, in the broiling sun, all the way to their somewhat distant little village to get a couple of shovels that must have been rare and valuable implements among these simple people. Much sand was dug out from around our wheels, and armfuls of branches were gathered from several of the bare surrounding acres to form a new foundation. After an hour or so, a group of natives pushed strenuously, and the car finally climbed out of its sand trap and struggled uncertainly across the treacherous, dry stream-bed to firmer ground.

Our immediate destination was a little government post that lies within 100 miles or so of the Abyssinian border and about 45 miles west of Lake Rudolf—a place called Lodwar, where a few white administrators and a small group of native police look after the welfare of the inhabitants of some 35,000 square miles of this barren region. And, at last, we made our weary way into that remote outpost of Empire on the afternoon of the twenty-eighth of June.

One of the basic reasons for the location of Lodwar, no doubt, is the Turkwell River, which is dry for much of the year but in whose bed, as the natives long ago learned, wells can be dug. It was not far from the main well in this usually nonexistent stream that we chose our camp site—a pleasant spot in a grove of wide-spreading thorn trees. Because this was to be much more than merely a temporary, overnight stay, everything was set up with especial care and with more than usual thought for our comfort and convenience. The spot we chose was convenient, as well, to the government *boma* (the District Commissioner's administrative offices), the Lodwar fort, and the few other structures of the tiny settlement. Even before the final details of making camp had been completed, we set off to pay our first call on the officials in charge of this extensive but thinly populated district.

We were cordially received by District Commissioner Whitehouse in his attractive and somewhat imposing flat-roofed house, which had been built, in the absence of any other structural material, of bricks made on the spot. We also met two other officials of the post who hap-

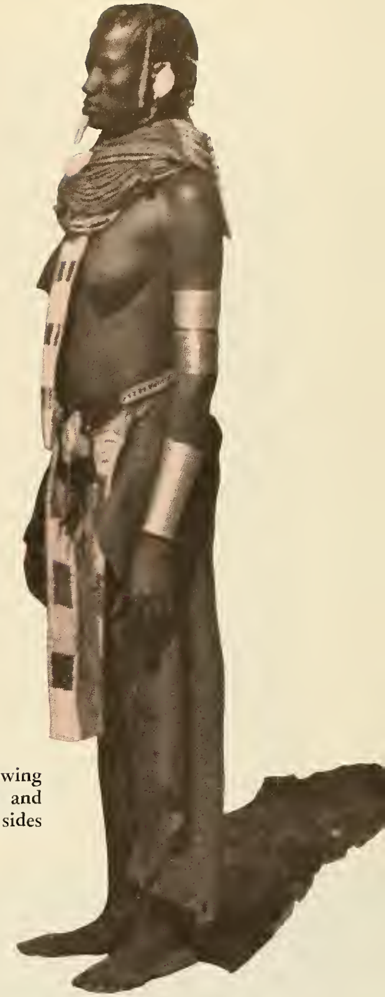
▼ AN OUTPOST OF EMPIRE: the *boma* at Lodwar, administrative center of the district. Only a handful of white men and three white women —one the wife of a former commissioner—had ever reached this spot



pened to be there at the time instead of off on tour of the district, and a visiting "locust control man." From them we learned something we already knew reasonably well—that we were far off the beaten path in a land to which few outsiders had ever come. Only a handful of white men and, we were told, only three white women—the wife of a former commissioner and two of her friends—had ever reached Lodwar.

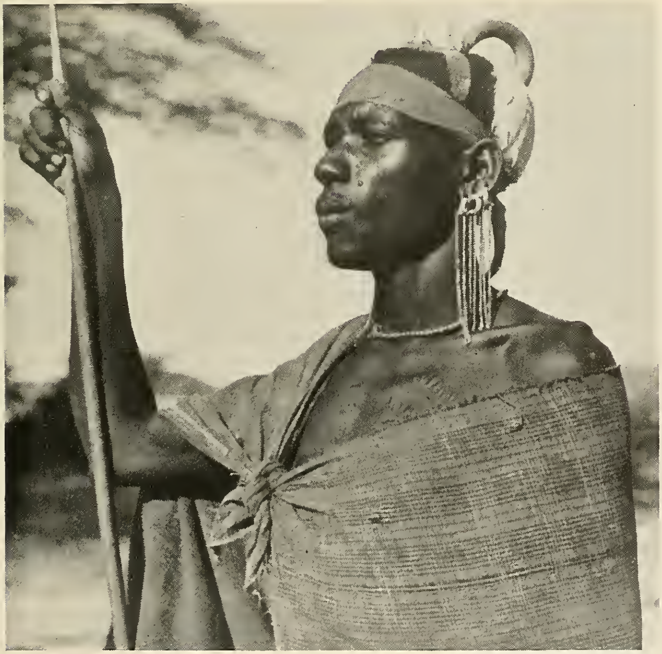
Our purpose in coming to this region was to study, photograph, and collect among the Turkana. Mr. Whitehouse, himself deeply interested in the welfare of these natives, assured us that he would be glad to help in every way possible. He immediately assigned one of his tribal policemen (members of the Tribal Police are recruited from the Turkana) to accompany our party during our stay in the district. Our policeman was named Loichamba, and he was a sturdy chap of splendid physique, with the usual fine carriage of these natives. His uniform consisted primarily of a neat blue cloth kilt edged with red, bearing in front the initials T.D. for "Turkana District." He also wore a headdress of ostrich plumes, a large pair of metal earrings, and an ivory lip plug as big as a ping-pong ball, which stood out vividly before his black chin. As we were shortly to learn, Loichamba was as useful as he was ornamental. He came to be of the greatest assistance in our work, accompanying us on all field trips and spending the rest of his time in our camp, representing "The Law."

The detailed studies that the expedition was to make were certain to be time-consuming and difficult. Before turning to that phase of our work, however, we were anxious to visit Lake Rudolf, which, surrounded by this arid portion of northern Kenya Colony, is undoubtedly one of the world's least-known extensive bodies of water.



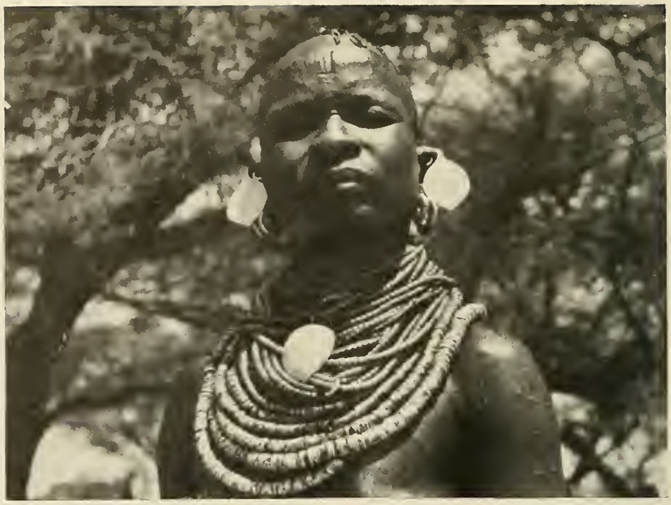
➤ A TURKANA WOMAN in full dress, showing the native mode in arm bands, necklaces, and ear decorations. The hair is shaved on both sides

▼ A LODWAR DANDY. In addition to other accouterments, the Turkana carry seven- to nine-foot spears



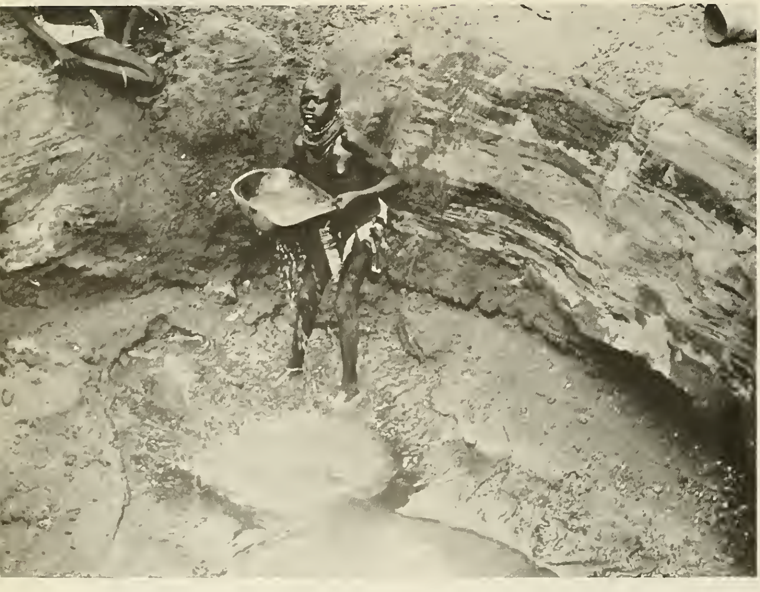
Unlike East Africa's other great lakes, Lake Rudolf has no outlet. Lying some 250 miles northeast of Lake Victoria and reaching northward into Abyssinia, it is fed by the Omo River and some smaller streams that flow from the north, as well as by the usually dry Turkwell River, which rises on the northern slopes of Mt. Elgon and floods down toward Lodwar during the rainy season. Not yet truly a salt lake, it has come, in the course of time, to be something less than fresh, though its brackish waters are somewhat unpleasantly drinkable. Too, it is slowly shrinking, constantly giving up by evaporation just a little more than it gains from the streams that feed it. Unlike most of Africa's other great lakes, its surroundings, except perhaps in the north, have little to recommend them. When one considers its remoteness and the harshness of the surrounding country, it is not surprising that Lake Rudolf, which was discovered only in 1888, is so little known and so seldom visited. At Lodwar, however, we were within 45 miles of its western shore, and we felt impelled to visit it.

On the third day after our arrival at Lodwar we started for the lake. Leaving several of our "boys" behind to keep the camp in order, we left in the morning with two safari cars and one truck, accompanied by the Assistant Superintendent of Police, Mr. Griffiths, and our Loichamba. We were quite conscious that difficulties lay ahead. The road was a mere track in most places, but a month or so earlier the Commissioner had driven over the route, and we followed the faint trail he had left. Time after time we sank deeply into the heavy sand and had to be dug out. Under the strain, one of the cars broke down, and we had to send back for repairs. Thus it was well along in the afternoon before we finally came to a halt amid the sand and scrub about a mile and a half from the water's edge. We had ridden as far as our cars could take us but still had some distance to go.



▲ A Turkana housewife with her treasure of beads made of ostrich eggshell. Note also the earrings and discs

We were bound for a little fishing camp that an earlier commissioner had built on a sandspit a short distance out in the lake. It was a simple place, consisting of nothing more than a few thatched huts, or *bandas*. In order to reach it, we had first to reach the lake shore and then to cross the shallow intervening stretch of water in a small, flat-bottomed skiff.



▲ The girls must water hundreds of goats and cattle from river-bed wells like this. Sometimes the water is 20 feet below the surface

It was fiercely hot there in the scrub, but, as had happened before, a considerable gathering of Turkana quite suddenly appeared. They no sooner learned that our duffel had to be carried to the lake than they wanted to help, so shortly we were on our way—a long, irregular foot safari, with bundles and packages of varying shapes and sizes balanced on almost every mud-daubed head.

So shallow was the water where we reached it that we had to wade out for 50 yards or more to the rowboat, and many trips were necessary before our luggage, our bedrolls, our supplies, and ourselves were finally delivered beside the *bandas* on the sandspit. Our arrival startled thousands of bright pink flamingos into the air, and almost as many big white pelicans. As the great birds wheeled and fluttered above the sandspit and over the vividly blue water of the lake, they seemed to shimmer in their flight until it was hard to distinguish one bird from another.

The sandspit supported almost no grass. In fact, there was little vegetation of any kind except a few clumps of palmetto scrub that rattled dryly in the breeze. But we had no sooner dropped into our camp chairs in the welcome shade of the thatched roofs than the natives went to work to prove what a fisherman's paradise this remote spot actually was. Dinner that evening—yes, and all the other meals we had there—revolved primarily about dozens of freshly caught *tilapia*, or perch, a fish that exists in the lake in enormous numbers. The ones we ate were small, but some varieties grow to immense size. A hundred-pound Nile perch, we were told, is not uncommon, and we were assured that others much larger had been caught here. Incidentally, the fact that Nile perch are common in landlocked Lake Rudolf suggests that the lake may once have had an outlet to the Nile.

It seems strange that a region offering so little in the way of vegetation should be so rich in life that is dependent upon these brackish waters. Never for a moment while we were on what we called our enchanted isle could we fail to be conscious of the countless lovely birds. The fishes, which can be caught so readily with seines and fish traps, must be almost unbelievably numerous, and they, in turn, may explain the presence of the crocodiles. We saw any number of them as they floated silently past, not far from shore. None visited the sandspit while we were there, but we found their eggs in the sand, and they must regularly come ashore in large numbers somewhere thereabouts. Hippos, too, were in the vicinity, rising and sinking from time to time out in the lake. They seemed to be watching us, and the natives assured us that they were merely inquisitive and were kindly disposed toward visitors. Certainly they had no hesitation about coming ashore near camp during the night. We heard them grunting, and on our second morning we found their tracks within 30 feet of our huts, though they had returned to the water before dawn.

The morning we started back for Lodwar we found our new friends, the local Turkana, waiting for us on the shore. Once more they helped us carry our belongings back to where the cars had been left amid the sand and scrub. This particular group of natives, it was said, had formerly been unable to care for themselves because of the great aridity of the region in which they had previously lived. Consequently, by government direction, they had been listed as registered paupers and had been brought here to the shore of the lake in order to be taught to fish. Curiously enough, despite the many fishes in the lake, the Turkana were not inclined to draw to any great degree upon this supply of food. Thus, in the comparative absence of other food supplies, some of them had suffered from dietary deficiencies until the situation was largely corrected by the use of more fish, and especially of more fish livers, which, in the past, these Turkana had discarded. Their general health had thus been improved, and under the direction of a government-trained native "fishing expert," these people are now learning how to live—and to live reasonably well—on fish, together with such products as the nuts of the dom palm, which they grind and cook. They are pitifully poor, of course, for their only commercial product is a small amount of rough camel rope, which they make from the fibers of the palm. So when we rewarded them for the help they had given us by distributing some 30 pounds of strong trade tobacco, which they love, they were almost pathetically grateful.

Our return to Lodwar, except for

▲ **Mrs. Morden** was hostess to the District Commissioner at the expedition's Lodwar camp

➤ **A pleasant spot** in a barren land: the camp beneath wide-spreading thorn trees at Lodwar

▲ Harry Selby, assistant hunter, with two Nile perch he caught in Lake Rudolf. Some weigh 100 pounds or more

frequent difficulties in the sand, was almost entirely uneventful. On the way, however, we came across a herd of Grant's gazelles and tried, as best we could in that rough going, to "pace" one of them. We got our car up to 35 miles an hour on a fairly level stretch, but the animal we were following suddenly decided to leave us behind. It outdistanced us so rapidly that we estimated its speed at not less than 45 miles an hour.

By now we were ready seriously to begin our work among the Turkana. Already we had made quite a beginning on the motion picture record, and Mr. Lewis had a good start on his collection of spears, knives, and shields, earrings and lip plugs, anklets, necklets, and various other bits of decoration, costume, and equipment.

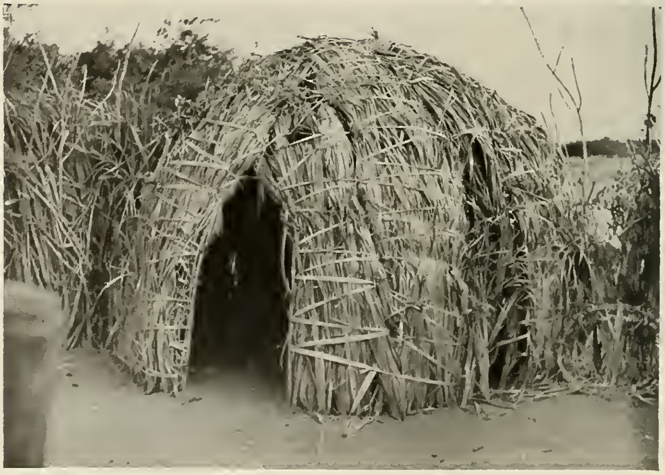
The Turkana, we learned from the British administrators, are divided into some sixteen territorial groups, but their divisions and subdivisions do not end there. There are 28 different blood groups (clans) based on paternal relationships; and other group organizations variously subdivide this widely scattered tribe. There is a chief for each Turkana group, and a headman for each subgroup. Natives pay their taxes on the basis of clan membership.

The aridity of the country necessitates a nomadic life, and the villages are not in reality villages at all. They are always temporary, being composed of nothing more than crude huts of branches, leaves, and grass. Furthermore, each is inhabited only by a family group—a man with his wives, children, and such other relatives as are not at home elsewhere. No such group is apt to include more than a score—or, at most, two score—of people.

The men are often very tall, many well over six feet. These taller ones are inclined to be very slender, but there are others who are not only noticeably shorter but also sturdier, more muscular, and more given to Negroid characteristics, which are less evident among the taller individuals. Loichamba was of this stocky type. The women, in general, are some four to five inches shorter than the men.

The Turkana subsist, for the most part, on their cattle, sheep, goats, camels, and donkeys. They milk all these except the donkeys. Milk actually forms one of the most important parts of their diet, and they not only drink it fresh but also after it has soured. They eat clabbered milk, too, and make a kind of liquid butter called *ghee* (a Hindustani word) which serves them both as food and as an oil with which they grease themselves. They pay almost no attention to agriculture, and the British administrators have been unable to interest them in widening their vegetable diet. The country does not really lend itself to agriculture, but even in the stream beds where a few things could be grown, they raise nothing but a little kaffir corn. The dom palm and a few berry bushes supply them with some food. The Turkana often bleed their animals, catching the blood in wooden bowls and mixing it with milk or consuming it raw and fresh.

The men and boys tend the herds, and the women milk and water the animals. Sometimes the very small boys help the women with these tasks but not after they have reached adolescence. In the absence of natural water holes, wells have to be dug in the beds of the usually dry streams. The water is sometimes found in holes no more than five or six feet deep, but we saw several that went down twenty feet or more. The task of passing the water up from the bottom of these



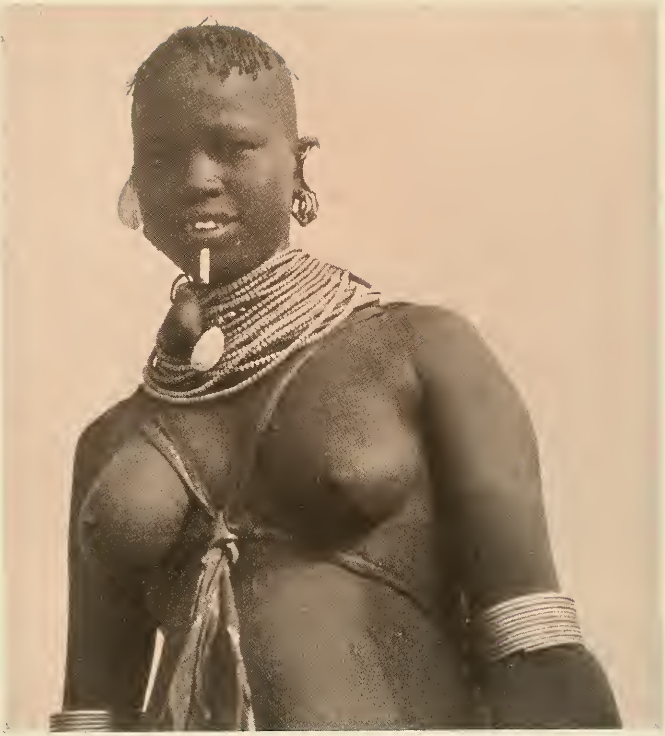
▲ The natives, loving the out-of-doors, spend little time in their sleeping huts. The villages rarely include more than 40 people big pits in bowls seemed ordinarily to be performed by girls, who poured it into little wooden troughs from which the herds drank.

The weapons carried by the men are comparable to those carried by other East African tribes. The spears, which have leaf-shaped blades, are generally from seven to nine feet in length. The shaft is made of wood, and the tip of the handle, as well as the blade, is made of iron. Usually these are carried in well-matched pairs, and the points, when not in use, are protected by leather covers. Every man also carries a club which is not unlike a hocky stick in shape. Many of them wear wickedly effective knife finger rings; and circular, bracelet-like knives are worn on the wrist. These are ordinarily protected by leather sheaths.

Religion seems to have no very important part in the lives of the Turkana, although they appear to reverence a high god. They do not seem to subscribe to formal beliefs and prayers, but some witchcraft is practiced. Its details, however, are hard to uncover, and witch doctors as such do not seem to exist. Still, as natives often try to conceal their secret beliefs and practices, it may be that some among them are credited with mystical powers and are designated as witch doctors.

Life is not easy in this remote land, but the Turkana nevertheless seem to be happy and good-natured. Among their limited pastimes, dancing is by all odds their favorite. They have dances during the day, and they have them at night. They sometimes even carry them on for days without apparent letup. There are hunting dances and war dances, dances that have to do with their herds, and others that are meant to bring good luck. And in all of them, everyone seems tireless.

One of the most interesting dances we saw was held at Lodwar, where it was arranged for us by the District Commissioner, and we were able to record a part of it in motion pictures. The story behind it was a pastoral one, and both men and women took part. Even the children hopped and skipped about the edges and were interested spectators, though not actual participants.



▲ **THIS YOUNG LADY** is the daughter of a chief. The Turkana recognize 28 different blood groups based on paternal relationships

The dance began late in the afternoon, and it took the dancers some time to "warm up." There were, in all, about 100 of them from the country round about. A number of the men wore clusters of pink, white, and orange plumes, and some wore short goatskin aprons, wooden sandals, necklets and pendants of beads and ivory. Most of them were naked, however, except for the usual cloak of brown cloth knotted above the right shoulder or possibly an abbreviated skirt of cloth made by wrapping a length of cloth about the middle and tucking in the end at the waist. Some adorned themselves with wide arm bands of metal and other decorations of copper wire and even cowrie shells. Almost without exception they wore great lip plugs of ivory, bone, or metal in their lower lips. Some of these plugs, prominently white against their black chins, were little smaller than hens' eggs.

The women wore goatskin aprons front and back and decorated their ears heavily with great metal hoops or discs or with a series of small metal ear-hoops. There were necklets of beads and ostrich shell and anklets of iron. They also wore lip plugs, though these were smaller than those of the men, and some—long and thin as cigarettes—were made of copper wire or aluminum. The women shaved their hair on both sides of their heads, leaving a center section that was smeared with fat and wound into tight curls as if for a permanent wave. Sometimes these curls hung over the ears and forehead almost like a shiny rope fringe.

There was not a great deal about

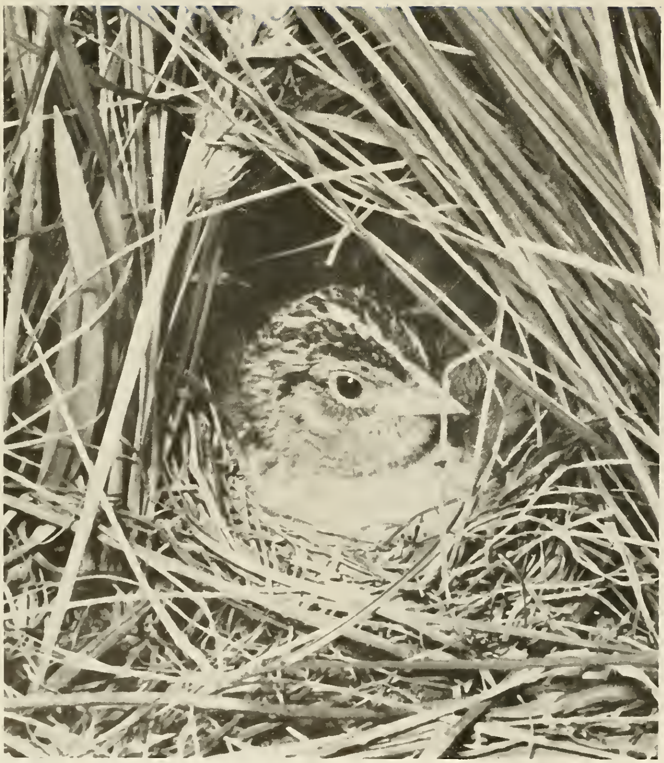
Continued on page 191

◄IT IS
a shy little sparrow
of the grassy fields

A bird with an insect-like voice

By
GEORGE A. SMITH
Photographs by the author

Grasshopper Sparrow

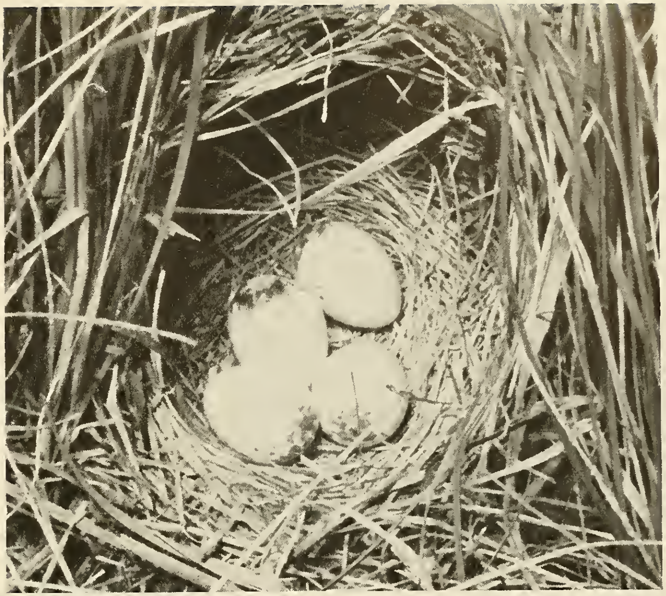


THE grasshopper sparrow (*Ammodramus savannarum*) is a common little bird in the eastern part of the United States, but because of its seclusive habits and its thin, insect-like voice it is not generally known. Indeed, its tone is very near the upper limit of human audibility and will, therefore, give you an opportunity to test your hearing. Many persons cannot hear the song at all. It is almost exactly like that of the meadow grasshopper and sounds something like *tsick, tsick, zee-e-e-e-e-e.* The grasshopper sparrow lives in grassy fields and seldom takes wing. When it does fly, it rises only a few feet above the ground.

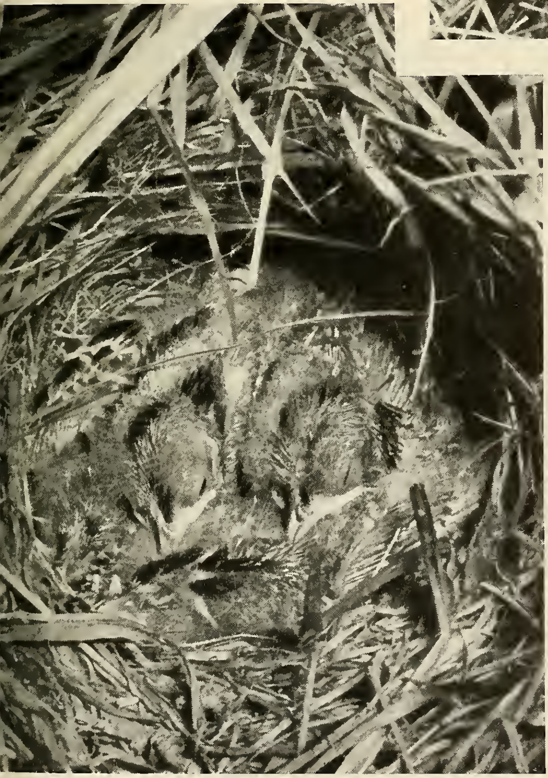
The nest of the grasshopper sparrow is rarely found, because it is cleverly concealed under a covering of grass. To avoid giving as much as a clue to the location of its nest, the bird enters the immediate area by way of a devious pathway through the grass.

◄ITS NEST
is cleverly concealed
under a covering of grass

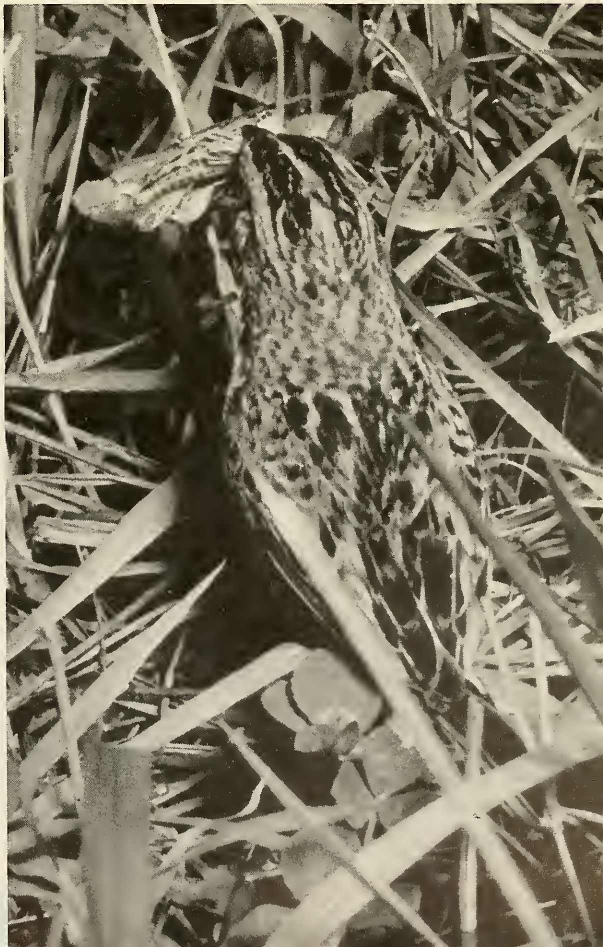
➤ THE WHITE EGGS
are spotted sparingly
with black and a
delicate shade of lilac gray



⮟ THE DULL BROWN FLEDGLINGS
are practically invisible
in their grass-lined nest



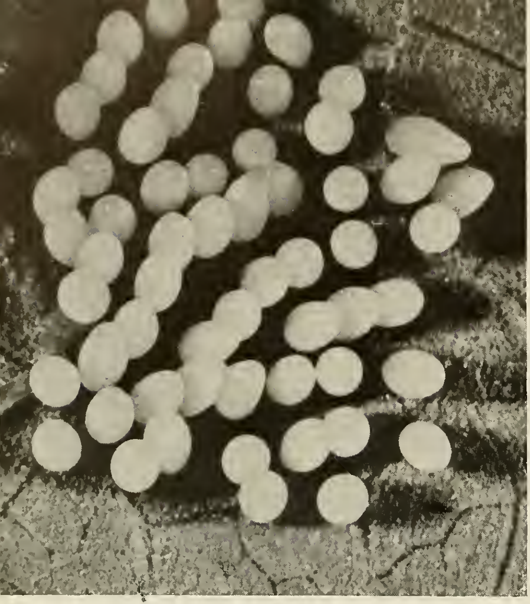
➤ JUSTIFYING ITS NAME.
The grasshopper sparrow
lives on grasshoppers and smaller insects
that are plentiful in grassy fields



MEXICAN Bean Beetle

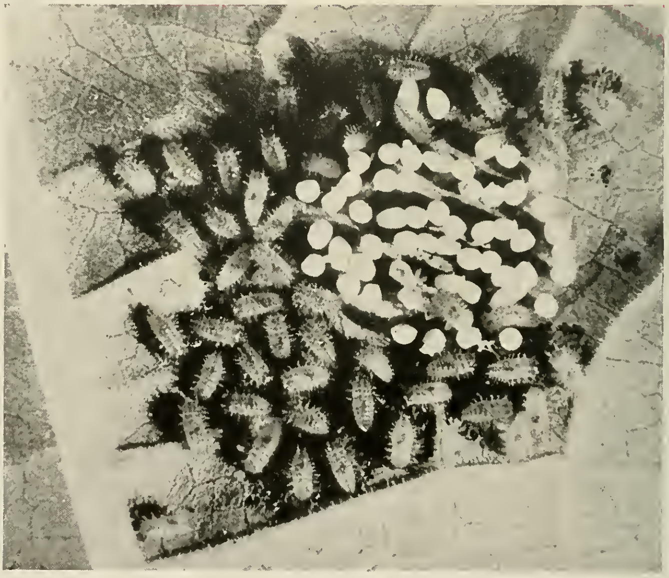
The life story of an insect that rapidly made itself at home in most parts of the United States

By John C. Pallister
Photographs by Lynwood Chace



▲ A cluster of 59 eggs of the Mexican bean beetle fastened by their ends to the underside of a bean plant leaf. Each is about as big as a pinhead

NEARLY 100 years ago when men had just started to study the insects of the western United States, they discovered a rather uncommon beetle in the semiarid regions of southwest Texas, southern Arizona, and northern Mexico. It was oval, nearly hemispherical in shape, about one-fourth inch long, yellowish in color, with small round, black spots, eight to each wing cover. This rather attractive little beetle was destined to become famous—or infamous—as the "Mexican bean beetle" and to rate as one of the potent scourges of the American gardener and farmer.



▲ Having emerged from the eggs in large numbers, the young Mexican bean beetle larvae begin devouring the bean leaf

But in 1860 southern Arizona was the northern outpost of this beetle. Farther south, in the more luxuriant areas of central Mexico and of Guatemala, the beetle was much more plentiful, again disappearing in Panama where the climate was too humid for it. Some ten years earlier Mulsant had described this insect from specimens obtained in Central Mexico, although what are now known to be merely varieties he described under at least four different names. For many years entomologists knew it as *Epilachna corrupta*, but in the 1930's *E. varivestis,* which Mulsant had applied to the typical form, was accepted, and this name is used to the present time.

This beetle belongs to the Coccinellidae, commonly known as ladybirds or ladybugs. Unlike most of the Coccinellidae, which are carnivorous and feed upon aphids and scale insects, this group, including some other genera besides *Epilachna,* are phytophagous, or plant-eaters. This great difference has moved many students of insects to consider it advisable to classify these plant-feeding species as a separate family. Other biological and structural similarities are so marked, however, that the *Epilachna* and the others still remain as one of the major subfamilies of the lady beetles.

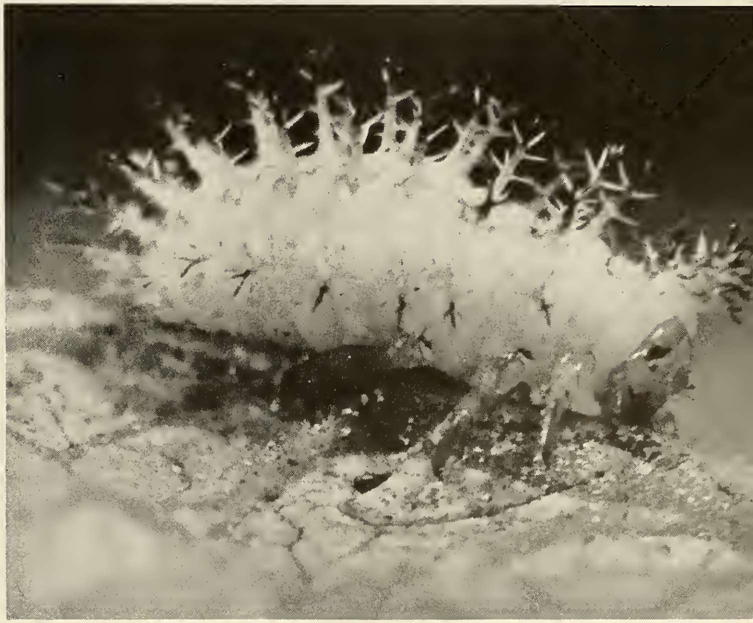
In their native home the insects fed upon a great variety of plants, largely of the Leguminosae or pea family. Some of the wild species of the beans were the ones generally consumed, but with the planting of the snap or butter beans in the gardens of the early settlers of the western states, the insects found a new source of easy living and developed quite a preference for them. The Mexican Bean Beetle was beginning to be noticed feeding on bean plants in the southwest United States as early as 1864, and by 1883 it was reported from Colorado as a pest. It spread rather rapidly throughout the western states until it ranged as far north as Colorado and Utah.

The mountains to the west stopped its spread into California, and the more arid plains to the east barred its progress in that direction. In 1920, the beetle was suddenly reported from three counties in north-central Alabama. It had made a commercial "jump" across this great distance, supposedly by means of a carload of alfalfa hay shipped from Colorado. By the end of that year the beetles were found established in thirteen counties. Government entomologists now realized that they had a serious pest to combat. A general quarantine to try to stop the spread of the insect was established. This quarantine had to be abandoned the next year because the insect had jumped the boundaries of the quarantine, and by the end of 1921, it had covered a vast area in northern Alabama, Georgia, and the eastern part of Tennessee. At the end of the next year it had spread into the western part of North and South Carolina, eastern Kentucky, and southern Ohio. In 1927, it had advanced to take in most of Virginia, Maryland, Pennsylvania, all of Ohio, part of New York and Michigan, and it had even been found in isolated spots in Canada. By 1930, southeastern Canada and all of the United States east of the Mississippi, with the exception of a strip along the Gulf of Mexico, was overrun by this bug. It is strange that while it was pushing so rapidly north, the beetle did not seem to spread southward to any great extent, and even now it occurs only spottily in the extreme south. The environment seems not to be just right in this area for the development of this creature.

All this time, while extending its range, it was causing tremendous damage to the bean crop of the eastern United States. Heretofore, beans had been one of the most easily grown and productive of the staple crops of the country. People did not know how to combat this strange bug. The problem was brought vividly to my attention in the summer of 1926 while collecting insects for the Cleveland Museum of Natural History. I was working the hill country of southern Ohio, and it was in this hilly submarginal land that the failure of the bean crop meant disaster to the struggling, hard-working farmers. When it became known that there was a "bug man" in their region (and news travels fast in these hills), delegations would assemble along the roads to waylay me to ask aid in saving their beans from the "yellow bug," as they termed it. I couldn't offer much help other than to suggest very thorough spraying with arsenate of lead.

The adult beetles come out of hibernation, where they have spent the winter months under collections of brush, trash, or leaves, as soon as settled warm weather arrives. Some may, however, delay their appearance until well along into summer. Because of this slowness on the part of the beetles, beans planted as early as possible after late frosts sometimes suffer less damage than those planted later. After feeding on the tender young bean plants for one to two weeks, the females start to lay their orange-yellow eggs, each depositing 500 to 600 of them in batches of 40 to 75 on the underside of the foliage. The eggs are elliptical, nearly twice as long as wide, and are carefully attached at the end so that they all stand vertically. They are about 1/20 of an inch long.

The eggs hatch in a week during warm weather but may require at

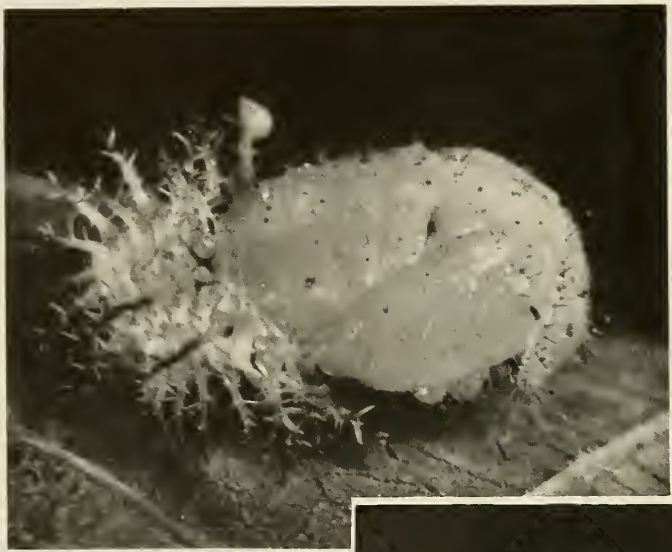


➤ THE LARVA is protected by six rows of black-tipped, branching spines least two weeks under more unfavorable conditions. Out comes a whitish or yellowish larva covered with six rows of branching spines, black-tipped on the ends. It feeds voraciously for two to five weeks, depending upon the temperature. The feeding is almost always on the underside of the leaf, and this makes irregular patches on the leaves. The upper surface quickly dries out, killing the leaf. When first hatched, they all feed together. If the leaf is somewhat dry, the first hatched may devour the remaining, unhatched eggs. As they grow older, they still retain their gregarious habits but tend to split up into small, scattered groups.

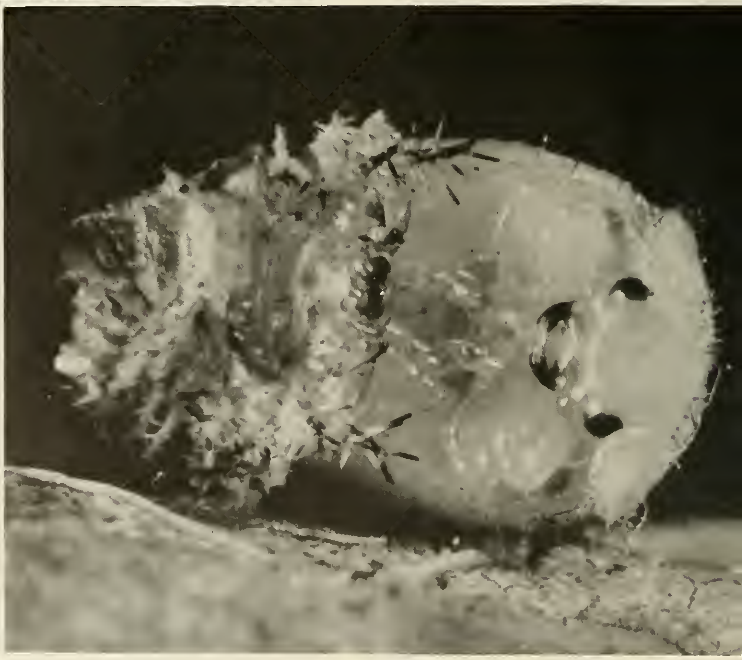
Their spines serve the larvae in protecting them from hungry birds. Chickens and guinea fowl, although feeding on other insects in a bean field, will pay no attention to this spiny food. Toads also will not touch them. There are, however, some insects that do not mind the spines. Among these are tiger beetles and carnivorous ground beetles. Carnivorous stink bugs of the family Pentatomidae are known to spear these larvae with their long beaks and suck them dry. When full-grown, the larva is about ⅓ inch long.

It is now ready for its last larval molt. Like all Coccinellids, it fastens the tip of the abdomen to a part of the plant and starts to wiggle out of the larval skin, not entirely shedding it but pushing it back until only the tip of the abdomen remains in the skin. This is the pupal stage, which lasts for five days but may drag out much longer in the cool weather of fall. The pupa is yellowish and remains quiet until about to shed its skin in the pupal or last molt that the insect goes through.

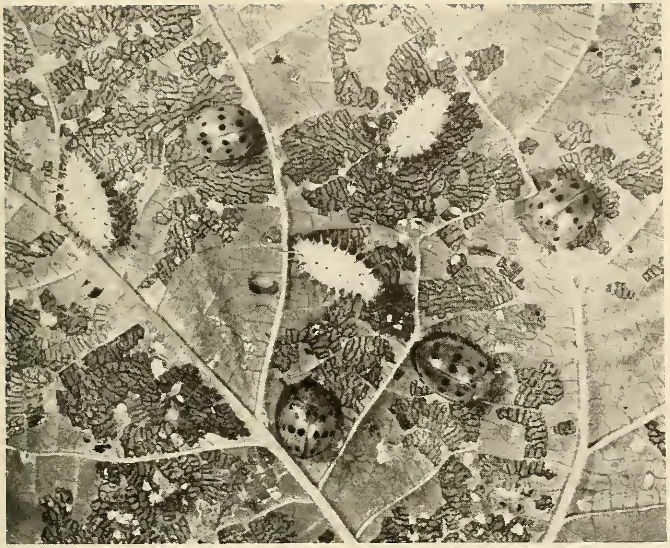
It is the adult beetle that now emerges, but what a sorry looking creature it is! The wing covers, or elytra, are soft and flabby, pale in color, without the pretty black dots. It doesn't remain so for long. In a few hours the elytra have hardened.



▲ WHEN READY for the larval molt, the Mexican bean beetle does not wriggle entirely out of its spiny skin but is held by the tip of the abdomen remaining within. The adult beetle will emerge by breaking out through the upper surface of the pupa

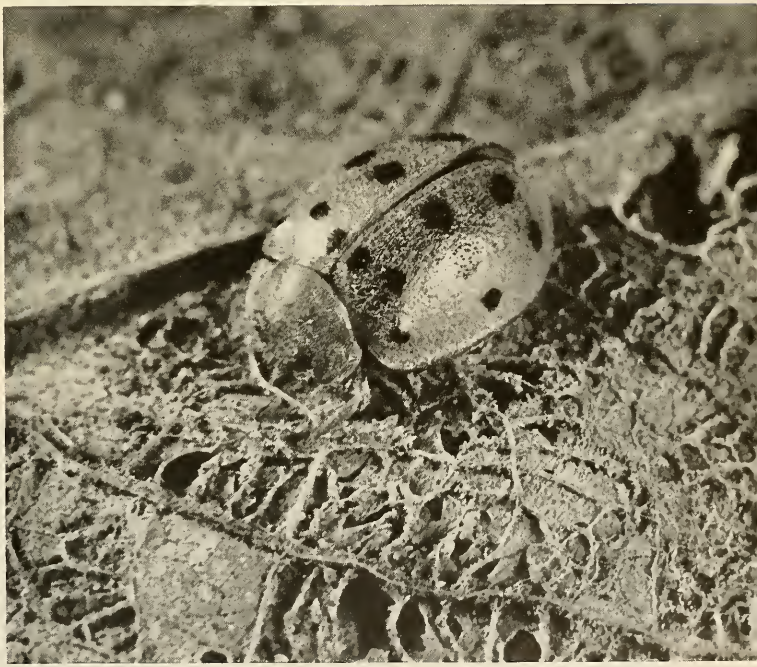


➤ MAGNIFIED VIEW of the undersurface of the pupa. It has been detached from its fastenings on the plant for photographing



◀ ADULTS AND LARVAE of the Mexican bean beetle. Note the places on the leaf already eaten away. When the undersurface is consumed, the leaf quickly dries out and dies. These insects can kill the foliage of a bean plant in a short time

▼ THE MEXICAN BEAN BEETLE is one of the farmer's most destructive pests. This shows a magnified adult beetle feeding on the underside of a bean plant leaf. Spraying with one pound of magnesium arsenate to fifty gallons of water is recommended



The color has strengthened to a bright yellow, and the sixteen black dots have appeared. These dots are sometimes variable in size and number, which led Mulsant to believe he had at least four distinct species. We now regard these variants to be subspecies or geographical forms.

The adults are strong fliers and travel long distances hunting for new bean fields to devour, for they are almost as voracious as the larvae. Not only do they eat the foliage but sometimes even the pods and stems. They are comparatively safe from all natural enemies, for like all true Coccinellids, they exude a yellowish secretion from the joints of their legs, which is very ill-tasting. It would take a strong-stomached bird to make ladybugs a regular diet. This secretion will stain the fingers of anyone who picks up a lady beetle and may even irritate sensitive skins.

Although snap beans and field beans seem to be the favored food of the Mexican bean beetle, so much so that many home gardeners have given up trying to grow them, other members of the bean family are also attacked. Lima beans, cowpeas, soybeans, hyacinth beans, and closely related plants, such as alfalfa, kudzu, and sweet clover will serve as food if the bean beetle's favorite food is not at hand. Bean growers have to wage a constant but none too successful war against these little pests. The use of arsenate of lead has given way to magnesium arsenate or calcium arsenate. One part calcium arsenate with four to eight parts hydrated lime is dusted on the plants. One fault of a dust control is the difficulty of applying the dust to the undersurfaces of the foliage where the insects are feeding. A spray control of one pound of magnesium arsenate to fifty gallons of water seems to be much the better, especially if the spray is directed onto the underside of the leaves.

The Man Who Grabbed A Shooting Star

Ellis Hughes' skill and daring in moving a 15½-ton mass of solid iron ended in a curious tug-of-war in the law courts

By Paul M. Sears

"GOE and catche a falling starre . . .," taunted the poet John Donne. He figured it couldn't be done, and most sensible folks would agree. But 300 years later a resourceful Welshman named Ellis Hughes took the poet at his word, startling the scientific world and sending lawyers and judges scrambling through the legal records of bygone ages in search of a precedent—a precedent for the ownership of a falling star.

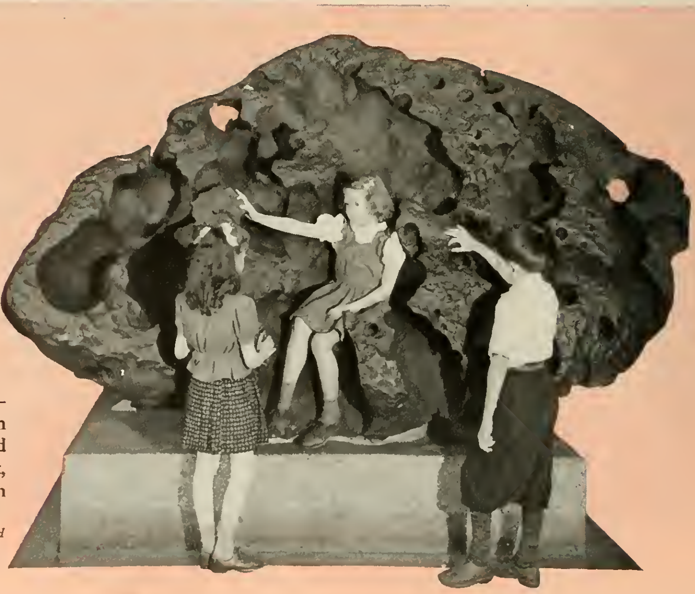
True, falling stars, or shooting stars (scientifically called *meteorites*), had been found before. Every respectable museum in Europe and America boasted a specimen or two, usually an unimpressive pebble-sized lump of rusty or blackened iron, sometimes with heavy stony material mixed in. It was Ellis Hughes' luck to stumble across a shooting star weighing 15½ tons—and then to run away with it. Perhaps "run" is the wrong word. But he indisputably packed up the thing and took it home, thereby providing certain Oregon lawyers with some lively professional exercise.

Before he tangled with shooting stars and judges, Hughes had been a miner in Wales and in Australia. He had learned his trade uncommonly well; otherwise he could never have made off with his staggering astronomical treasure trove. In 1902, he came to America and settled with his wife and son in the dense, wet, still primitive forest along the Willamette River south of Portland, Oregon. The Hughes family lived modestly; the nearest neighbor was a mile away, and Ellis Hughes took plenty of time off for his hobby—prospecting for minerals around the near-by hills.

He had a prospecting partner named Dale. One day the two men came across a most peculiar rock, on a hillside within a mile of Hughes' home. Perhaps one of them actually stubbed a toe on the thing; more likely he spied it first and swung a tentative, testing mallet. The rock wasn't big, at first sight, but it was pure metal, rust-flaked and immovable. The result was wild excitement.

They began to dig. Hughes called the find a "reef"—a good Australian term for a treasure lode. They determined the metal was iron, for gold or silver would have been heavier. But the prospects for an iron mine seemed wonderfully rosy, even so.

Then they came to the end of the reef. They had dug entirely around a weirdly-eroded, bell-shaped lump of iron measuring ten by seven feet across and four feet thick. The lode, they figured, continued farther underground.



➤The Willamette Meteorite—largest single shooting star found in the United States. When Hughes and his prospecting partner came upon it, they thought they had located an iron mine

Photos by AMNH

Dale and Hughes kept their find an absolute secret. They might have slammed their fists on the nearest bar and babbled the news that would have started another gold rush—or, in this case, an iron rush. Instead, they nosed around to discover who owned the land on which the "reef" lay. The answer, by coincidence, was the Oregon Iron and Steel Company, a concern with conveniently absentee ownership. Hughes and Dale hoped to buy that particular piece of land.

Then, after months of secrecy and suspense, they learned that their iron reef was actually a meteorite, the remains of a giant shooting star that in a past age had blazed to earth and embedded itself in this remote Oregon forest. The records do not say how they learned, but as a proper assay can always tell the difference between meteorite iron and any other metal, they probably had an assay made. Certainly they refrained from mentioning to the assayer that their sample had come from a 15½-ton mass, for the secret remained as well kept as ever.

But Dale lost his enthusiasm when this news showed that the iron vein could not possibly run farther underground. He left for Alaska and thereby missed his chance to share unsuspected—and unsettling—honors with Hughes.

Hughes' home stood only three-quarters of a mile from the giant meteorite. The forest wilderness ensured privacy, and the distant neighbors kept to themselves. Hughes decided to fetch the great chunk of iron quietly to his own property. For motive power Hughes had himself, his fifteen-year-old son, and a run-down, undersized horse. Hughes' other asset in this preposterous bid for glory was the mechanical savvy he had picked up in the mines.

First he built a rough heavy-duty timber platform that rolled along on sections of tree trunks. House movers use similar apparatus to roll buildings down a road. He set this crude cart in place beside the meteorite and then levered the 15½-ton mass up and out of its resting place. Not without major difficulties, of course. But fortunately the deep pits and channels that eroded the face of the meteorite like wormholes made it easy to attach chains. Whenever he gained an inch, Hughes jammed another wedge between the meteorite and the bottom of the hole. Finally he capsized the monster directly onto the waiting cart and chained it down.

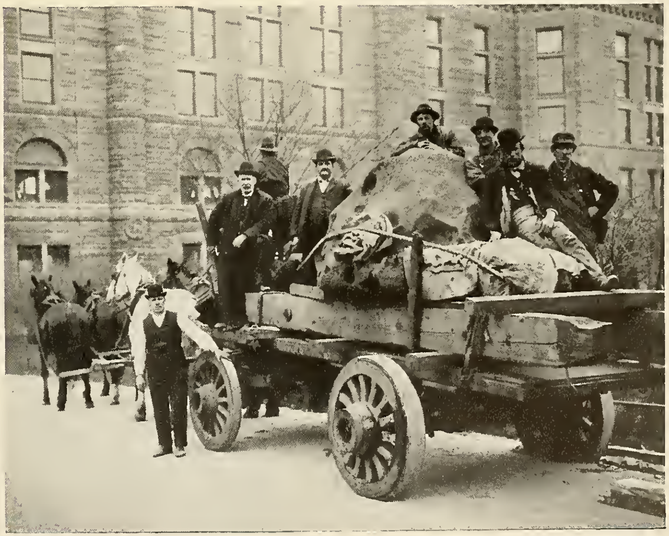
Then he found the horse couldn't pull the cart. That would have licked most men, but Hughes thought he knew the answer. Sailors can't pull up a heavy anchor by hand, so the anchor chain is tied to a vertical post with spokes sticking out for handholds. The sailors push the post around, and the chain winds up. It's called a capstan. Hughes built a homemade capstan and set his horse to winding a wire rope around it. The other end of the rope tugged at the big cart with the ungainly meteorite perched on top. The arrangement was so ingenious it deserved to succeed, and succeed it did, painfully and by inches.

The wet forest soil repeatedly mired the log rollers, and some days they were lucky to pull the cart its own length. Other days they did better, but 50 yards was the best day's haul. From August to November of 1903, Hughes and his son and the small bedraggled horse thus toiled fantastically in the soggy forest. Finally they reached Hughes' own land. Feeling safe at last, Hughes proudly announced his find, counting on publicity to bring buyers to his door.

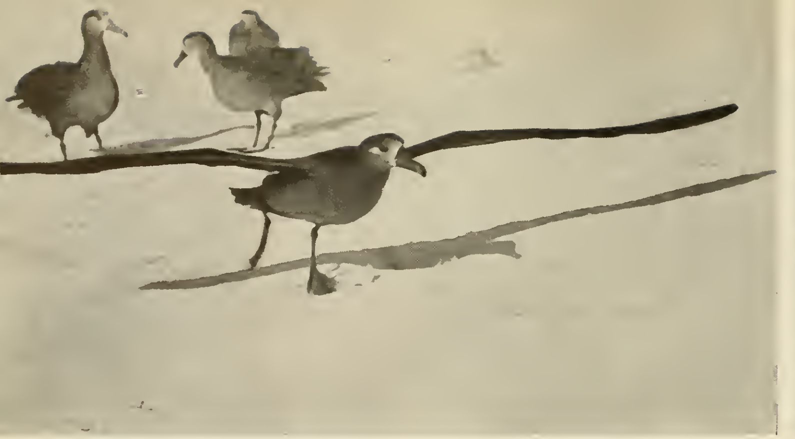
Instead it brought trouble. True, a gratifying swarm of curiosity seekers trooped out from near-by Willamette and, when the news spread, from as far as Portland. But there also came a peremptory message from the Oregon Iron and Steel Company, demanding that Hughes give up the meteorite. Hughes pluckily replied, "Nothing doing," and thereby set a lawsuit in motion.

The case came to trial in county court, and the decision quickly went against Hughes. But public sympathy and admiration were strongly on his side, and his lawyers appealed to the Oregon Supreme Court. By now many scientists were

Continued on page 191



➤ Transporting the meteorite to the American Museum—an easy job compared with Hughes'. He moved the mass almost a mile, with the help of only his son, a horse, a wooden cart, a capstan, and his own indomitable spirit



➤ **Black-footed Albatross** running for the take-off. It needs a head wind and must run a considerable distance to rise

➤ **Gaining altitude** after the take-off. Very few wing strokes are now needed

Flight of the Albatross

The king of sustained flight comes to land only to raise its young and is a thrilling sight for sailors in the unfrequented reaches of the sea

By Thomas M. Blackman

Photographs by the author

ALBATROSSES may be regarded as creatures of the air rather than of the land and water; for although they are entirely dependent on the sea for their subsistence, they pass by far the greater part of their time flying. They remain for long periods well out of sight of land and appear to be almost entirely independent of both land and water for the purpose of resting.

When viewed for the first time by the ocean traveler from the deck of a vessel, an albatross never fails to excite wonder and admiration by its untiring and apparently effortless gliding. Its thorough mastery of the air represents one of the more remarkable achievements of nature in adaptation to a special environment.

Because albatrosses frequent the open expanses of the ocean and come to land only for a part of the year to raise their young, they are not familiar to most persons. They choose small and remote islands as nesting places—spots seldom visited by man. To the great majority of persons, therefore, they are reminiscent chiefly of stories of the sea and of Coleridge's immortal poem of the Ancient Mariner, in which we find reference to the superstition of sailors regarding the albatross—surely an outgrowth of their wonderment and admiration for these birds:

And I had dane a hellish thing
And it would work 'em wae,
Far all averr'd I had kill'd the bird
That made the breeze to blow.

A fallacy has persisted right up to the present time in dictionaries and general reference books to the effect that albatrosses may attain a wing expanse of seventeen feet. In reality, the measurement from wing tip to wing tip varies from about seven feet in the case of several of the smaller species to ten or eleven feet in the Wandering Albatross, which roams the southern parts of the oceans around the globe. But a bird with a ten-foot wingspread needs no exaggeration when you see it at close range.

The spectacle is imposing at any time, but to observe the aeronautical skill of the albatross at its best you should see the bird following close in the wake of the ship or circling about it in sweeping curves when there is a stiff breeze and a rough sea.

The great bird takes a position perhaps twenty feet above the level of the deck and twice that distance behind the stern of the vessel, and follows for hours at a time, with its long wings outstretched and curved slightly downward. At intervals it may be seen to turn its head this way and that, as though scanning the surface of the water for anything edible that may have come to the surface. Occasionally it drops behind and floats buoyantly on the water, perhaps to pick up some-

➤ **Black-footed Albatross and young.** A bird of this size can have such a large wingspread because its "elbows" project so far back. The Wandering Albatross reaches 10 or 11 feet from tip to tip

Black-footed Albatross coming in from the ean to land on Sand Island, at Midway. In rmy weather, the hardy seafarer may tumble ad over heels as soon as its feet touch

thing that it has seen, but it soon overtakes the ship and follows as before. Apparently tiring after a while of such an easy life, yet still showing almost no perceptible movement of its wings, it sweeps downward on one side of the vessel to within a few feet above the waves. Banking sharply, it clears one of them and descends into the trough before the oncoming wave, until the tip of one wing barely touches the water. Then, just as the observer imagines that the bird must surely be caught by the advancing wave, the huge pinions, still rigidly outstretched, slowly resume the horizontal position, and the albatross is lifted, apparently by the air forced upward by the heaving water, until it is carried, still with wings rigidly extended, over the crest of the wave. This amazing feat is perhaps repeated a time or two. Then, without apparent effort, the bird glides upward and forward in a sweeping half-circle before the bow of the ship and, continuing downward at a greatly increased speed, passes the vessel on the other side and rises again to its chosen position at the stern.

It seems likely that these birds are first attracted to a ship through curiosity, but on approaching it they soon find that the motion of the vessel creates air currents that will help support them on their continued search for food. The habit of following ships is not, however, common to all albatrosses. In the North Pacific it is usually the Black-footed Albatross that does it.

It has been said, with very good reason, that an albatross in flight looks unlike all other birds. It is also true that the wings are unique in that their extra length is acquired by prolongation of the first and second parts of the wing, the upper arm and the forearm. The flight feathers, in turn, are much shorter than one might expect in such a remarkably long wing. In other long-winged birds such as the swifts, swallows, terns, and frigate birds, the reverse is the case. There the flight feathers contribute a very great deal more to the length of the wing, while the upper arm and forearm are much shorter. The presence of the bones throughout a far greater part of the albatross's wing gives it much greater rigidity. This rigidity and the long and narrow shape of the wing make it much more similar, both in appearance and function, to the wing of an airplane or sailplane.

This peculiarity of the albatross's wing may be detected in many photographs of the bird in flight. The elbow and wrist joints clearly show as prominences on the front edge of the wing. When the bird is standing with its wings closed, the elbows extend so far back that

they often show as angular projections on each side of the rump. These features are clearly shown in the accompanying photographs of the Black-footed Albatross.

Although very graceful when launched in the air, an albatross appears ungainly and sluggish on the ground. When taking off, it has to have a head wind and must run a considerable distance before attaining sufficient speed to rise from the ground. Once it is launched, however, very few strokes of the wings are required to gain speed and altitude.

At Midway the Laysan and Black-footed Albatrosses made regular use of the road clearings and the sloping sand beaches for taking off. Coming in for a landing in stormy weather was always hazardous, and many birds were seen to tumble over as soon as their feet touched the loose sand. But the real danger was for those unfortunate individuals who were caught by the unsteady wind as they glided in at reduced speed and were blown into one of the clumps of Scaevola bushes with which the beach was lined. The bird was often left hanging by its half-closed wings among the branches, quite unable to free itself. It was not uncommon to find a bird in that predicament, but it was easy to release it if aid had not come too late.

When walking between the clumps of bushes near the beach in stormy weather, we not infrequently met an albatross as it swept around the bushes only a few feet from the ground to make a landing. On two or three occasions I just avoided having one collide with me. One man, while walking with two others, was hit in the chest and nearly knocked off his feet in this way. The bird fell in a confused heap on the sand, but after struggling to its feet and taking a few seconds to recover from the shock, it continued its way on foot, kicking the sand up at every stride and running with its wings half spread, apparently not seriously injured.

That the birds should take such chances when coming in from the ocean need not surprise one. No doubt they have been flying in to the islands in the same manner ever since they first frequented them, without the risk, until quite recently, of meeting and having to avoid any moving object taller than a bird of their own kind. It must be much easier for one of them to glide over the head of another albatross walking on the ground than to miss a man who might suddenly appear in its track.

Thirteen different species of albatrosses are generally recognized. Of these, nine fly over the waters of the southern oceans from about 25 degrees S. to the Antarctic Circle. These have their breeding grounds on various solitary and remote islands lying between 30 degrees S. and 55 degrees S. In most cases the islands are far from human habitation and from regular trade routes. Some of the more notable are the Auckland Islands, Chatham Islands, and Campbell Island, in the South Pacific; Tristan da Cunha and Gough Island in the South Atlantic; and Kerguelen Island and Crozet Islands in the Indian Ocean.

Of the remaining four species, one, the only species confined to the tropics, has its breeding ground in the Galápagos Islands. The other three nest on various small islands in the western part of the Pacific, between the equator and about 30 degrees N.

When one marks on a map of the world all the places where albatrosses are known to breed, one cannot fail to be impressed by their apparent love of freedom. It is as though these magnificent birds had retreated before the advance of navigation. It has always been the larger birds that have had most cause to fear the arrival of man, with the dogs, rats, and other enemies that generally accompany him.

It appears probable that the conditions existing on all the oceans between the latitudes of 60 degrees N. and 60 degrees S. might meet the requirements of life for the albatross, whose food consists mainly of squids and other forms of animal life picked up from the surface of the water. It is therefore significant that all the ocean areas that have been used most for navigation through history are entirely without any breeding albatrosses. These include the entire North Atlantic,

◄ Laysan Albatrosses on Eastern Island, Midway. Only in the Western Pacific or near the Galápagos are you likely to see an albatross north of the equator

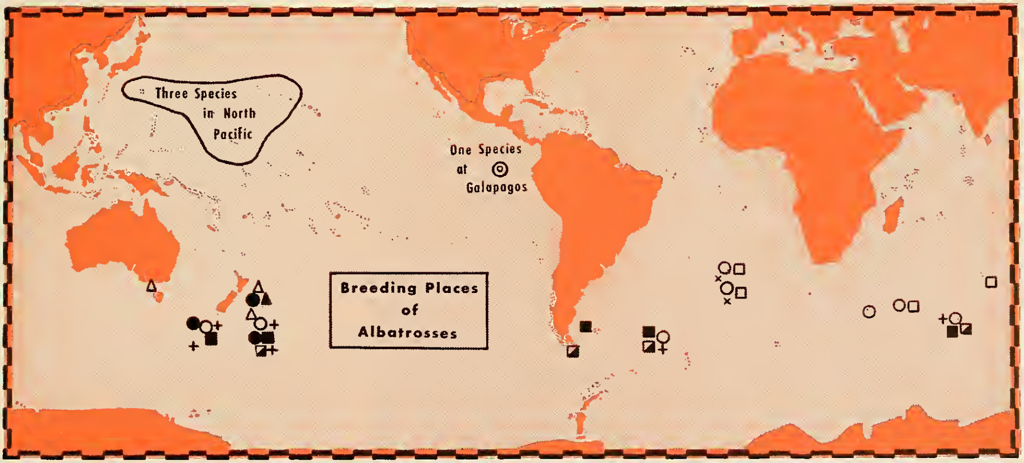
➤ THE UPWARD CURVE of the flight feathers near the end of the wing is only seen during a vigorous down stroke or when the bird is soaring in stormy weather, as shown here

the northern part of the Indian Ocean, and the seas extending from there to, and including, all the part of the Pacific Ocean that is most thickly studded with inhabited islands. At the same time, the Galápagos Islands, some of the more recently discovered small islands of the Hawaiian chain, and other comparatively insignificant islands between Hawaii and the Asiatic mainland, little frequented by man, still have flourishing breeding colonies of albatrosses.

It is difficult to account for the absence of their nesting colonies from a great area in the southwestern part of the Pacific by any other reason than man's presence. This seems true even if we assume that these birds may have originated in the southern hemisphere and been guided more toward the eastern part of the Pacific Ocean than the western part by the prevailing winds that sweep northward with the Humboldt Current.

Since the occupation in recent years of some of the small islands in the North Pacific, albatrosses have been greatly reduced in numbers by the interference of man. But happily several of the small islands of the Hawaiian chain on which the Laysan Albatross and the Black-footed Albatross breed were set aside by President Theodore Roosevelt in 1909 to form the Hawaiian Islands Bird Reservation, ensuring the survival of those two species. Less fortunate has been the third and largest species of these fine birds in the North Pacific, the Short-tailed Albatross. It had its breeding grounds only on the Bonin Islands and other small islands lying to the southeast. This bird appears to have almost disappeared in recent years. It is now seldom seen flying over waters where it was formerly quite plentiful.

The present status of the largest of oceanic birds of the North Pacific illustrates the importance of giving due consideration to the conservation of rare members of the local fauna whenever innovations altering the character of the environment are contemplated. Especially is their welfare a worthy cause when the creatures have economic or aesthetic value and are without harmful habits.


Three Species in North Pacific
One Species at ◎ Galapagos
Breeding Places of Albatrosses

North Pacific

- D. *nigripes* (Black-footed Albatross)
- D. *albatrus* (Short-tailed or Steller's Albatross)
- *Diomedea immutabilis* (Loysan Albatross)

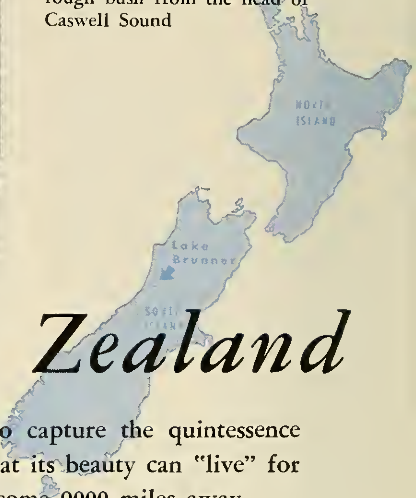
Galapagos Island

- ◎ *Diomedea irrorata* (Galapagos Albatross)

Nine Species in Southern Oceans

- ○ *Diomedea exulans* (Wandering Albatross)
- ● D. *epomophora* (Royal Albatross)
- △ D. *cauta* (White-capped Albatross)
- ▲ D. *bulleri* (Buller's Albatross)
- □ D. *chlororhynchos* (Yellow-nosed Albatross)
- ◪ D. *chrysostoma* (Gray-headed Albatross)
- ■ D. *melanophris* (Black-browed Albatross)
- × *Phoebetria fusca* (Sooty Albatross)
- + P. *palpebrata* (Light-mantled Sooty Albatross)

◂ MANY BEAUTIFUL LAKES adorn New Zealand. Here the author sits beside Lake Marchant, after two miles through rough bush from the head of Caswell Sound



Discovering New Zealand

An expedition seeks to capture the quintessence of a remote land so that its beauty can "live" for Museum visitors some 9000 miles away

By GRACE E. BARSTOW MURPHY

All photographs by ROBERT CUSHMAN MURPHY

THE two places chosen for collecting the materials for our New Zealand exhibits for the American Museum's Whitney Hall of Pacific Bird Life had exactly one point in common. They were both known for their dreadful weather. The sub-Antarctic islands called the Snares, swept by gales and rain, were severe, majestic, gorgeous, and exciting in their harsh beauty, cold and uncomfortable to live on. Lake Brunner on South Island was also swept by almost steady rain. But it was a different proposition—a beautiful and charming spot, fascinating in infinite variety, comparatively comfortable.

The notes I made between the Snares trip, which ended December 6, 1947, and the Lake Brunner work, which began January 23, 1948, bristle with descriptions of New Zealand botany. We saw strange and wondrous things, what with daisies and fuschias growing all over large trees, and young trees changing their whole appearance before becoming adult. For the first time in my life I felt neck and neck with Bob* outdoors. He knew little more of New Zealand plants than I did. In fact, when I played Eve and named the things I liked, I would actually find those very names in my noted naturalist's notes!

These botanical problems were as upside down as the seasons. I gradually learned to think of December as late spring and January as full summer. But reaching high over my head to pick a daisy, and learning how kauris and lancewoods transfigure themselves when they grow up, were ever new experiences.

We could not have worked up the Lake Brunner Exhibit without the several weeks of orientation given us before the work started—time for knowledge to be won and to mellow into familiarity. The complicated, isolated flora that developed through the ages, with scores of kinds of plants, gradually fell into its pattern. We had been sent by the generous New Zealand Government, or taken by kindly friends, all over South Island. We had been set down in every type of bush and had marveled at every type of landscape from wildest, somber Alpine scenery to windswept pastures, and coast lines where headlands embraced sandy beaches. We had seen other lakes enclosed by snow-capped mountains and had picnicked among beech trees beside rushing brooks. When we finally reached Lake Brunner, we were at least partially educated in New Zealand out-of-doors.

There were five of us, in working clothes, setting off together in the pouring rain that summer morning: Bob Murphy, of course; Dr. Robert A. Falla, who was the other Bob of the Sub-Antarctic Expedition†; our two assistants, Ronald Balham and Baughan Wisely; and I. The job of another museum exhibit, in all its details, loomed ahead as a big one. There could be no coming back half around the world, so mistakes were out. Bob Murphy looked as though he had something on his mind.

The lumber launch, "Tikinui," makes a tour of Lake Brunner every morning. As we boarded her, a white heron sat on a treetop

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* Robert Cushman Murphy, Chairman of the Bird Department, American Museum.

† See NATURAL HISTORY Magazine: October, November, December, 1948.

▲ **The lumber camp** at Hohonu, on Lake Brunner, where the expedition lived while collecting the New Zealand exhibit for the Whitney Hall of the American Museum

▲ **New Zealand flax** at Lake Brunner. Its beauty enhances every landscape. It was the source of most Maori textiles and is still important industrially

across the cove. It was the only explorer from the only heronry in New Zealand, at Okarito, 150 miles away.

The rain hid the mountains and made even the near shore misty. Yet we saw at once what a typical picture of primitive New Zealand nature this perfect choice would give. Tall flax lined the lake shore above small beaches. Rimu, the red pine that always looks like green waterfalls, towered above. The bush behind gave promise of containing everything we wanted.

Bob Falla had already tried to draw a general plan of the exhibit as he and Bob Murphy had imagined it. Bob Falla and I could not see how everything could be fitted into the eight- by ten-foot space allotted. It seemed to me that the whole Museum would be needed to suggest adequately how New Zealand looks and what lives and grows there. There is magic in the skill that can create a representative exhibit out of such quantities of material. Somehow Bob Murphy took it home in camera and packing boxes, notes, and paints. From now on, we will have New Zealand in New York. Will the hordes who look realize the Chinese puzzle confronting the expert who collected, planned, evolved such an exhibit—the sum in artistic form and in scientific detail of our lake, our bush, the mountain range we loved at sight?

The flax by the water's edge, in eight-foot spears with longer flower stalks now gone to seed; the matai with its mossy, ferny trunks, and slender perching lily leaves growing from its high, gray-lichened branches; the great rimu with its look of falling waters, must all be shown at home. No picture of New Zealand could be complete without red-flowering rata trees, always in bloom somewhere; a fuschia tree, all over purple blossoms; the poisonous, shiny tutu, generally low-growing; the manuka whose ghostly mist of flowers had passed; the plumes of toetoe; the miromiki, the lovely towai, a host of others, and, of course, the ferns. For of everything that grows in all New Zealand, the ferns make their way into one's very soul. High-towering tree

▼ **A gnarled old totara** supporting many "air plants," or epiphytes, overhung Lake Brunner's almost uninhabited shore. The totara, related to the yew, is usually tall and straight. The Maoris used it for canoes and carvings

▲ THE KIEKIE (*Freycinetia*) sometimes almost completely covers large trees in the bush with its graceful, slender leaves. It is a climbing member of the screw pine or pandanus family

ferns, of which there are a dozen varieties, ground ferns with six- to eight-foot fronds of a score or more kinds, tiny, filmy ferns on branches, swathe every spot. Yet even as one dreams of ferns, the trees flood back insistently into one's thought. The whole growth must be taken home if one would give New Zealand.

"Tikinui" struggled on across the lake to the lumber camp of eight to ten small weather-beaten cabins. Great rimu logs lay on skids along the beach ready to be tugged to the mill back at Te Kinga. Their huge size made me think of Douglas fir on the Olympic Peninsula in the State of Washington.

A small, tightly built cabin had been assigned to us. We five hurried to it out of the rain. Ronald and Baughan had a big fire going in no time, and we hung our wet coats high on nails. We found one stool and four boxes to sit down on near the fire, but we were allowed little time for sitting. At 9:30 in the morning, we were called to tea served with sandwiches and cake. New Zealanders eat good food at least six times a day—seven, if one counts early tea in bed.

Rain fell heavily but did not stop our reconnoitering. It was a matchless spot! Everything we wanted seemed to grow there at its best, except red ferns and fuschia blossoms. I had set my heart on both of these for our exhibit. On the western seacoast, 25 miles away, red ferns had enchanted me. I was bound to bring all of you red ferns. I hunted everywhere in vain, feeling that as long as such remarkables existed, our Museum should tell our part of the world about them. We could not put one in our exhibit unless we found it in the section of the country we were bringing home. Every time I had a chance, I hunted for red ferns.

And all of us were hunting for fuschia blossoms. Bob Falla had said it was too late to find them in the midsummer month of January. I was most unhappy. But one day Ron dived into camp carrying a branch with one belated blossom. It meant that everyone at home could look at fuschias growing on a tree.

Our first walk took us along the beach, with its little, lapping waves. It was a striped beach of about fourteen narrow but definite bands of pebbles, sand, and driftwood, each band slightly undulating. It was a very pretty thing, an ingenious beach. Its pattern continued almost unbroken for a mile to the point of sand which marks the exhibit's center.

The edge of the forest was trimmed with flat, small-leaved cover plants. There were lichens everywhere, on stump and branch—apple green, dull green, bright green with red spores, yellow, orange. The mosses were varicolored, too, but not so gay as the lichens.

Toward the end of that first survey, walking down the beach, looking into the tangled, beautiful darkness of the bush, I saw Bob Murphy relax. In fact, he almost smiled, no doubt realizing that in spite of heavy toil ahead, the wealth he saw was what he wanted.

He portioned out the work. Baughan was to paint in water color each specimen as it came in. Ron was to gather material and press the plants. My job was to sew up specimens both for drying and for the formalin cans, to collect, and to help wherever I could. Because a mere wife is that necessary release of tension, a steam exhaust, I knew that offers or lack of offers to help were equally risky. The kind of collecting we were doing was indeed nervous work.

So I had my notes and pencil, or my book, in hand and succeeded pretty well, I think, in being either invisible or on the jump to help at whatever came my way. And I could always hunt again for that red fern I craved.

"Saw off that dead limb with all its growth intact," Bob called to Ron.

"Do you want this big piece of bark all over moss and ferns?" I asked.

"Yes, it's a good one. Put it in."

We hardly stopped that first day except to eat the good "cut lunch" brought from Moana. Before the warm, bright fire, we had a whole stuffed squab apiece, tomatoes fresh from somebody's garden, big sandwiches thick with butter, cake and tea.

Bob photographed and even began to speak again as the job shaped up in his mind. The clouds lifted, and he photographed the half-exposed mountains which rose in cadence like a melody far across the lake. He needed pictures of every kind of sky to choose from for the final designing.

I took a chilly swim. "Tikinui" returned. We left Baughan sketching the rosy leaves of the pepper bush, and Ron bringing in armloads of specimens. The two Bobs and I went back that first night to the pleasant inn at Moana. But commuting ended then. Mr. and Mrs. Watson at the lumber camp called Hohonu, gave up their own room to us in their little home.

The sweet smell of a summer morning greeted us as we started back to camp the second day. Bob Falla had returned to Christchurch. Big crates of supplies for our work had come and were loaded on the barge. They contained cans of formalin, 50 pounds of newspapers for packing, tools, jars, burlap bags, excelsior, and various other equipment for moving a cross section of lush virgin land 11,000 miles. A

▲ THESE conspicuous nursery nests of a New Zealand spider (*Dolomedes*) are often filled with hundreds of tiny spiders

▼ TOETOE, which resembles pampas grass, belongs to the genus *Arundo* and grows only in New Zealand. Its swaying golden tassels are wonderfully beautiful

▲ PROFESSOR LANCE McCASKILL, of Lincoln College, is giving the newly-arrived American an early lesson in local botany. Mrs. Falla, Mrs. McCaskill, and Margery McCaskill listen in

▲ A native species of scaup duck which the New Zealanders call "black teal." There are many families like this in various waterways

➤ Gray ducks, the commonest of the waterfowl, are at home in town or country throughout New Zealand

▼ Ronald Balham, of the New Zealand Fish and Wildlife Service, was a member of the party at Lake Brunner. In this picture, he is trapping and banding gray ducks to learn more about their dispersal

trunk contained preparator's equipment, photographic supplies, plaster for molds, and so on.

As the launch neared the shore I thought of how the tree line graphically interpreted the two so different exhibits my husband was bringing home. At the Snares, the roof of the only kind of tree is an even, uninterrupted line, with no tree taller than another and no branch exposed. The look of that even matting was as harsh as the feeling on one's fingers of the stiff, thick leaves. It gave an austerity to the landscape which the nervous evening flight of the millions of muttonbirds accentuated. At Lake Brunner all was warmth and welcome. Each tree grew in its individual way, not only in a great variety of kinds but also in a great variety of individual trees of each kind. At the Snares, we were cold and harried by discomfort. At Lake Brunner, I would sit in the shade of a fuschia tree beside the lake opposite the beautiful mountains. Near me, the collections were being completed in a suitable workshop. A stone's throw away stood the cottage to which Mrs. Watson cheerily called us to good, warm meals served in comfort.

When we first reached New Zealand we were constantly aware of the comparative lack of roadside flowers. I heard that there are some in early spring on North Island, but we saw almost none. Imported foxglove does not suit the landscape. What wild flowers there are largely consist of what I called "carpet flowers," a name everyone took up. They spread, flat to the ground, over large areas, pink or purple, yellow or white. We needed some in the exhibit. As the bush was heavy, they were hard to find.

I walked up the narrow logging rail track and, in searching, found two in a tree-denuded place. One was a tiny white asymmetrical one I knew. Its fine petals grow in two-thirds of a circle. The other was a still smaller, flatter plant, gone into cerise berries. With the white paperish one on the beach top, we had three kinds, which may sound dull and little, yet they had seemed an important part of New Zealand vegetation.

Baughan made line drawings of them as he does of all the plants, filling in with color. Mrs. Watson had opened another cabin for him so that he could work in comfort at a big table. Ron pressed my little plants. He had been pressing small white orchids when I came in. These grow high up on the older trees, leaves hanging down in slender curvings.

Bob handed me the specimens he was sewing into bags and worked on making bird skins. When made up, they are stuffed with excelsior and packed in cotton for their long trip.

Bob was, of course, everywhere at once, feeling faith in his assistants and contentment in the work. He made use of every scrap of sunshine by taking Kodachrome shots of scenery, plant associations, and detailed plant studies, such as a row of branches showing the development of lancewood.

Big boughs were nailed into the crates. We sometimes tied on leaf clusters in veils of cheesecloth. Yet even when leaves wither and fall off, their shape and size and habits can be figured out by men used to doing it.

After our first supper at Hohonu, Bob said, "Come on up the beach. I want to make a sketch of the plan for the Group."

We sat on a log, the beach in front of us, the forest behind, and the mountains rising out of the far shore four miles or so away. It seemed at first that to concentrate everything into a Group's small space, some shifting must be done. First we suggested moving the mountains, and then we suggested moving the lake. His design gradually came into being with the whole forest and forest floor, lush with growth, at the left, melting into a background of painted trees. Nothing was moved, except that the point was turned a little to run into the lake toward the right, leaving space for the moa we were to dig up the following week. The lake beyond the point merged into the background that Lee Jaques was to paint, with its mountain range exactly like the view in front of us. With the moa on the beach, ducks of several kinds and black teal in the water, tuis eating fuschia berries, a fantail flirting from a rata, a kiwi peering out from flax, and pigeons, tits, and others, we both felt content.

Bob later cut a small-sized tree fern. He photographed it from above to show the pattern of the fronds and heart. The fronds were cut off, measured, pressed in sections. Fresh fronds were preserved in formalin. The trunk was cut in two and tied up in a sack ready for boxing. Even old brown fronds, which fall like skirts around the upper trunk, were packed to go. Bob catalogued and tagged each specimen. Baughan edged all his sketches with notations. Ron changed the papers in his press each day and dried out the papers before the roaring fire. I sometimes helped him. He is taking extra care of lichens and mosses—a typical feature of New Zealand rain forest. Heavy rain often made indoor work hard because of little light. Yet Ron unwound his tightly rolled newspapers over each specimen with infinite care, so that leaf and frond and flower were perfect, all moisture gone. One of our special treasures—some bright blue toadstools—were sewed up in cheesecloth and dropped into formalin.

▲ THE SUPPLEJACK grows every which way and is the toughest, woodiest, and most luxuriant of the lianas. The Maoris aptly named it tataramoa, which means "trip up the moa." It also trips up people

Bob and I talked constantly of specimens we wanted. The list would grow shorter only to lengthen again as we added now discoveries. We collected tall, hard bracken. The lawyer vine, so named because when it gets its fingers on you, you can't escape, hangs over many shrubs and trees in deceitful daintiness. Unlike most vines, it grows upward on other stems or trunks and falls backward on the outside of its host.

Three women lived all year round at Hohonu, completely isolated yet cheerful—lovely women, with that good breeding and sensitiveness toward others that seems to be inherent in all New Zealanders, no matter what their station in life. Mrs. Watson took me up the logging track for tea with Mrs. Hall. We had buttered scones, cookies, cakes, far more than I could eat. As we went outdoors, a commotion bubbled at the door. Someone called: "A stoat!" I saw the family cat pounce under the house. It caught the frightened animal, which I brought to Bob in a jar. It is now in New York. For stoats must be killed. They are one of the imported pests that have injured the beautiful pristine New Zealand wildlife.

That same afternoon Mrs. Watson and I decided on a wider jaunt to hunt for my red fern. A high point, heavily bushed, juts far into the lake on the other side of our camp from the beach. One of the men took us in the small launch around the peninsula so that we could walk back through it over the rough track. The boat had hardly touched shore when I saw my lost love on a cut bank and, shouting its name, I dropped on my knees in front of:

THE RED FERN!

It was a little one but very red. Larger ones were found later.

We scrambled over roots and fallen logs and up and down in gullies. Many crowns of golden ferns glowed like lamps throughout the dusk-filled forest. It was a very bushy bush—a jungle with a vengeance. It was hung with lianas called supplejack, doubled up in knots and curves and twists. Everything was covered with something else growing on it. The rata vine, related to the crimson-flowering tree that also starts life as a vine, was very thick. It, with ferns and lichens and great long clumps of leaves of lilies, tangled the forest floor and all the space above. The trees were mostly totara and rimu and what the country people call birch.

When I spoke of birds, Mrs. Watson said, "There are very few birds here."

"Do you know why?" I asked.

She did not, and I told her the tragic story of New Zealand wildlife. The country had, in its isolation, developed a balance of nature in which there were no mammals at all except two small bats. The bird life was not only prolific, beautiful, and unique, but it was also adjusted to the absence of predatory beasts. When the pioneers came, they introduced all sorts of animals: deer, rabbits, hedgehogs, weasels, and, of course, rats. These, having no enemies, ran riot. The birds were wiped out almost to extinction. Now the Government and an aroused public interest are protecting what are left. But the dearth of birds is tragic. Our Museum expedition was allowed to collect *one* tui, *one* pigeon, and so on, as each individual bird is now guarded as far as is possible.

Mr. Watson, Mr. Hall, and four of the men took me on the logging tractor several miles into the hills. As we ascended above the lake, the lianas disappeared and the forest was more open, with rata and rimu predominating, and a thick undergrowth of coprosma and fern. Tree ferns were left behind as we climbed. I was happy to see a stand of the dainty umbrella fern and more red ferns. These, by the way, turn green when adult.

The rough, narrow-gauge tracks were laid on crude trestles over rivers and small gulches. As we went deeper into the bush, they were built on heavy ties laid across the same sized rimu logs brought down to go to the mill: 40 feet long, 18 inches or more thick. Heavy mist soaked through everything as we sat on the car edge swinging our feet, our knees brushed with wet bracken and sedge found in the areas devastated by earlier logging. High up above the lake, we were surrounded by great, straight trees. Only those with 2000 to 2500 board feet were being cut. It was freehold land, with no government supervision. Mr. Hall gashed the trees that were doomed—great beauties with hundreds of years of growth. The men felled them with a double-handed saw. With a system of cables, the donkey engine lifted the heavy logs, pulling them to the tracks and swinging them into place on the open cars, which were adjustable in length to fit the logs.

The waste of wood was terrible: all the branches, all the bark, and great stumps. Huge logs lay everywhere, unused and blackened. There would be no paper shortage were this wastage used. Enough fuel to warm a city lay about us. I had already seen how much wood was lost in the sawing process at the mill across the lake. I have seen it just as bad at home.

As we with our heavy load of logs rushed down steep grades, Mrs. Hall flagged us and gave me a load of ferns and branches she had gathered for us. She had found ferns we had not seen, and fungus, too. How could a woman who had never seen a museum like ours know our needs? Yet all our lives I've noticed that wherever Bob col-

▲ PRIMEVAL BUSH at Lake Brunner. The branches of the matai, or black pine, are heaped two feet deep with mosses, ferns, orchids, and other epiphytes lects, everyone else sets to collecting, also. One of the men brought him a green lizard, a gecko.

We had a wild time getting off that afternoon, packing and nailing the crates. The work was not finished, so after a week of digging moas at Pyramid Valley, Bob and I returned to Lake Brunner by ourselves. There's a little rail car that runs at night from Christchurch on the narrow-gauged tracks standard in New Zealand. It is designed to ensure perfect wakefulness.

As we stepped off at 6 A.M., a spot of gold came over the hills, and the whole gold ball followed so brilliantly one could not face it. The line of hills and all the world seemed to move toward it. A sweet-faced woman stood at the door of the small hotel, saying that early tea was ready for us. "I can't leave all this," I said.

She understood and brought the tray outdoors.

Instead of sunrise colors, shining light on ridges and purple shadows in the valleys made a different beauty. The sun had to travel high before topping the mountains and shining on the town. First it wasn't there, and then it was. We had hardly dared hope for the perfect day that dawned for us in that so rainy country. As we crossed the lake, every peak and every marking on each slope stood clear and sharp. The men stopped "Tikinui's" engine for camera studies of snow mountains.

Landing at Hohonu, sitting in front of the clear blue lake beneath the forested mountains, it seemed the most beautiful spot in all the world. After the mist and rain and hidden distance of our first visit, the clarity and warmth and smooth sun-dancing water seemed incredible.

We rowed to the sandy point and landed on an equally sandy island. Red deer had left their tracks for us. A pied oyster catcher flew above us. Some far-off birds swam in the lake. Up the dark river, sunlight, reflected from the water, ran down the flax leaves like a play of intermittent light in electric signs on Broadway. Manuka, of tiny leaves, swayed gracefully in the wind.

"You row down while I take pictures," said Bob, handing me the heavy, hand-hewn rimu oars.

Though I had brought my bathing suit, there was no time for swimming. Frivolities are not included in museum expeditions, nor are 40-hour weeks ever known to naturalists.

▲ THE TWO MILES of beautiful but heavy bush between Caswell Sound and Lake Marchant were hard going

Later, we rowed in the other direction, around the high, heavily forested peninsula, Bob's gun and camera loaded.

"Watch for teal," said Bob.

"There are gray ducks."

"I don't want those, only black teal."

Bellbirds were calling from the forest. A great darning needle with enormous eyes lighted on the stock of Bob's gun. Others mated on the wing. We beached on white stones. A black shag skimmed the water, yet there were few birds for such a wilderness.

A tui flew by, its white lace-shawl shoulder feathers showing against its dark iridescence. Great logs lay half submerged, a graveyard of trees. An eel lay on the stones in clear, deep water. Bushy trees, covered with red flowers, showed at the edge of the forest.

"That can't be rata," said I.

"No, it is kamahi," said Bob. "I'm going to break through to the track and take Kodachromes of yellow ferns."

I started to get out of the boat but fell asleep in a lump instead, after the night we had had on the rail car. Waking with the sun in my eyes, I waded ashore to explore while Bob was gone. Probably few people had ever been there before. After many months, I still see the graceful sedge growing from white stones, and the growth of all kinds, now so familiar and so dearly loved. Detailed study such as we had made—such as all naturalists always make—rewards in detailed memory of beauty.

One always makes discoveries. A very fragrant white orchid grew on low branches of host trees. It is called *autumnalis* because of its late flowering. White violet-like flowers grew with daisylike ones, all tiny, on the stones. Three fantails played about us in the trees—small flirting birds who want to know what's happening.

As we rowed back against a heavy wind, we at last found the clay we needed for the essential leaf molds, in the corner of the beach by the peninsula. Bob sliced off pieces into a basin, and we hur-

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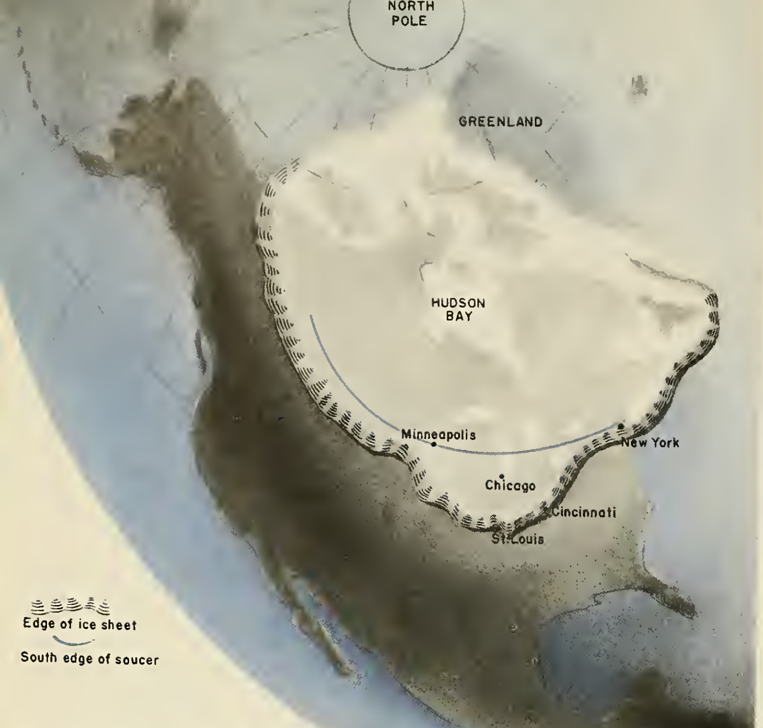


↗ THE SOUTH EDGE of the saucer-shaped dimple that the Great Glacier pressed in the face of North America is shown by the curved line here. The north edge is unknown because the territory has not been explored

Once the Great Lakes poured south through what is now Chicago, and they may do so again. The broad dent left by the weight of the Great Glacier is rising, and even Hudson Bay may someday be high and dry

By

RICHARD FOSTER FLINT

Professor of Geology, Yale University

UPS and

THE water surfaces of the Great Lakes rise and fall irregularly by as much as three feet. This does not seem like a large amount; yet in the harbors and the ship channels through which the tremendous commerce of the lakes is conducted, three feet may make all the difference between safe clearances and the huge costs of dredging the bottom.

In 1900, the city of Chicago completed a canal connecting Lake Michigan with the Mississippi River basin. The canal allowed a small part of the lake to escape southward toward the Gulf of Mexico, whereas all of the overflow had formerly passed over Niagara Falls. Years later the lake level began to fall, to the detriment of installations at many points along its shores. The city of Chicago was sued on the ground that its canal had caused the trouble. While the U. S. Supreme Court was considering the case, the lake level rose again, proving the city's innocence; and as if to reinforce the proof, high-water storm waves damaged shore property to the extent of millions of dollars.

Besides proving that you can't please everybody, these rises and falls of water level bring up the interesting question of their cause. Probably it lies in long-term changes in the weather over the Great Lakes region as a whole. But whether the changes result from this or from something quite different, the water fluctuations have focused attention on far greater changes in all the Lakes—changes that have been going on for many thousands of years. For this world's mightiest group of fresh-water bodies has had a startling history, the record of which is written plainly in the Midwest landscape. The story of how the events in that history have been learned and arranged in their proper order is a fascinating example of how natural science goes to work.

Ancient Beaches

To most travelers between Great Lakes cities and the East, the steep bluffs, beaches, and hummocky yellow dunes that mark the shores of the lakes are a common sight. Away from the immediate shores, many a tourist with an eye for landscape sees similar things along his route. The highway he travels follows a low ridge for ten or twenty miles. Here and there the ridge is replaced by a steep, grassy bluff. The ridge looks like a beach, and the bluffs like long, low headlands cut by the waves. Patches of knobby terrain suggest dunes, although instead of showing yellow sand they are covered with

DOWNS of the Great Lakes

grass. And in front of the bluffs, instead of blue lake water there is mile after mile of nearly level ground, its rich black loam showing in plowed fields that stretch away to the shore of Ontario or Erie or one of the other Great Lakes.

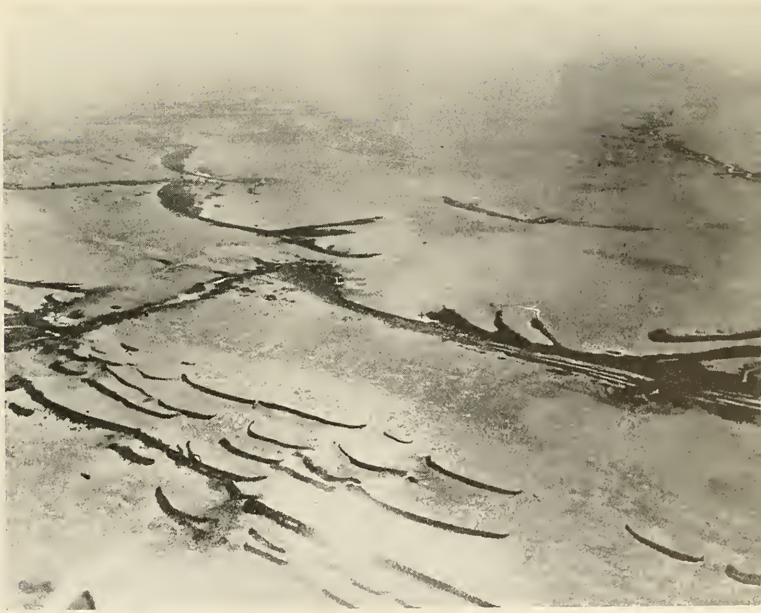
Such an assemblage of ridges, bluffs, and plains can only mean that the lake shore once stood here. It was abandoned long enough ago to permit vegetation to heal the steep cuts made by waves and to clothe bare wind-blown sand with grass. Yet the lake receded so recently that the washing of rain water and the slow creeping of the soil have done little to dim the original sharp outlines. Among the cities situated on former shore lines or on former lake floors are Chicago, Detroit, Toledo, Cleveland, Buffalo, Toronto, Saginaw, and Superior. All these cities occupy ground formerly under water, and all have some streets or roads built on broadly curving beaches or bars, raised a few feet above the surrounding flats and affording ideal natural causeways. The combined area embraced by such features is more than half as great as the combined area of the Great Lakes today.

So conspicuous is this array of former shores, high and dry above all the present lakes, that they were noticed and reported more than 100 years ago, during the settlement of the Great Lakes country. Between 1830 and 1840, a good half-dozen geologists, engineers, and surveyors published descriptions of the old shores, both on the American and Canadian side. All recognized what they were, but none guessed why the lakes had abandoned them. The right guess was not made until much later.

Dry Rivers

Gradually, the outlets of the former lakes were discovered. These outlets are the beds of great rivers, dead and abandoned like the shores that curve into them. The dry river beds lead away from the lakes toward the ocean, just as the St. Lawrence River leads away from Lake Ontario today. One of these old river beds, nearly a mile in width, begins on the western outskirts of Chicago and is the low-level line along which that city dug its canal in 1900. Another leads eastward across New York State to the Hudson River; for a time it must have given to Manhattan much of the volume that Niagara has today. Still another old channel, 700 feet wide, leading across part of eastern Ontario, was cut 40 feet deep into a mass of earth, stones, and boulders left by a former glacier. But the channel now contains only the biggest boulders, left behind because they were too big for the outflowing river to move. Their huge size tells us that the river must have been a swirling torrent, for it carried away everything of smaller size.

The Great Lakes today are a single connected system with a single outlet, the St. Lawrence River. The abandoned outlet channels seen along the high and dry old shores suggest that the Great Lakes basin as a whole is roughly like a very broad, very shallow, water-filled pan, with slight irregularities in its rim. A very little tilting of the pan makes the water spill over through any low place in the rim, in one direction or another. But the early naturalists kept thinking of the old shores as seashores.



➤ WHEN THE ICE SHEET MELTED, a large part of Canada rose. Hudson Bay therefore shrank, leaving these beaches and bars to show where the sea once extended. They are comparable to the ones that can be seen well inland around the Great Lakes

Photo Dept. of Mines and Resources, Canada made during some submergence of the land and later somehow lifted above sea level. One, W. W. Mather, writing in 1843, suggested that "The Gulf Stream caused a flow into Lakes Michigan and Erie from the Gulf of Mexico" and on across New York State into the Hudson Valley. This was a wrong deduction.

Such high-flown theorizing is all very well in the absence of many facts. But gradually more facts piled up, narrowing down the possibilities. It was found, first, that instead of having only one abandoned shore, each of the Great Lakes had many, one above another. Indeed, there are places in the Lake Huron basin where as many as five can be seen in a single view. Then it was discovered that in places the sand and soil in the old beaches and flats contained the fossil shells of clams and snails such as live in shallow lake waters today. From these facts it became apparent that the shores were those of lakes, not of the sea, and that the lakes had stood at several successive levels.

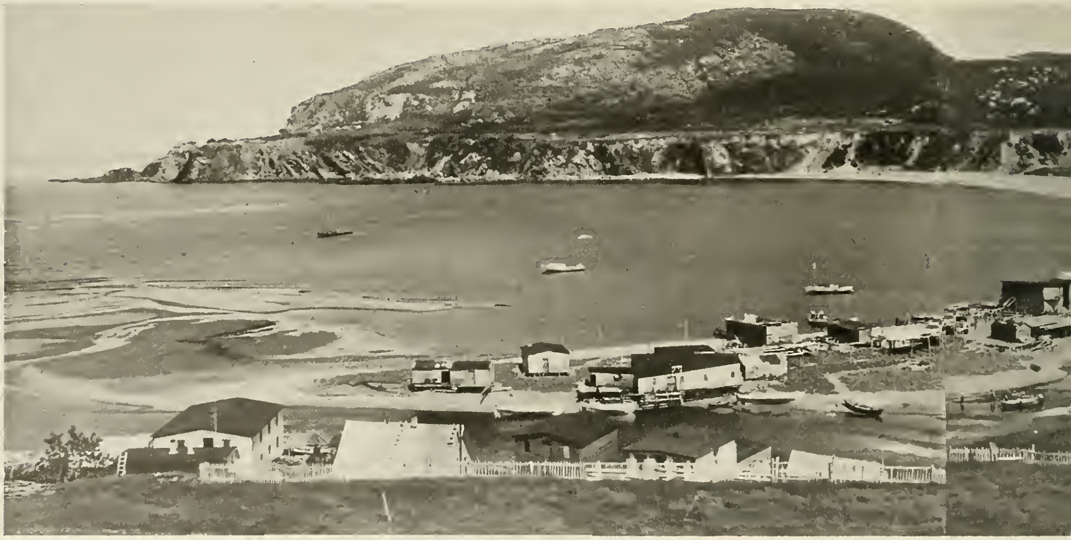
Barriers of Glacial Ice

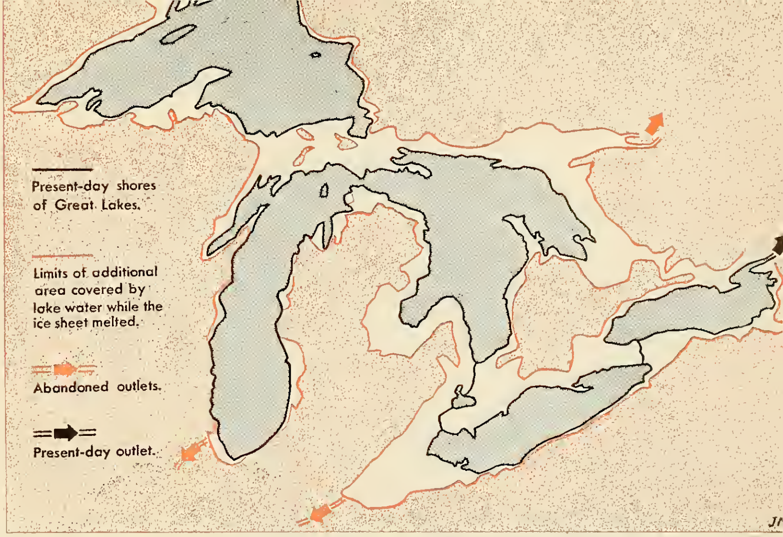
Next it was found that although the lowest, more recent shore lines run all the way around the lakes, the higher, older ones suddenly end toward the north and simply are not present around the northern sides of the basins. Meanwhile, it was discovered that wherever a gully or an artificial excavation cut through the beaches and lake-floor deposits, these deposits were built *on top of* the earth and stones left by the great glaciers during the Ice Age. This combination of facts showed that the lake shores were made *after* the glacial ice had melted. It suggested further that the reason there were no shore lines in the north was because there the lakes had washed against the glacier itself. In other words, each lake had a northern shore of ice, which subsequently melted and left no record of itself whatever.

While this picture of a huge system of former glacier-dammed lakes was becoming clear, an even more remarkable fact appeared. The shore lines were found to be not horizontal but tilted. The higher and older the shore line, the more steeply it is tilted. All of them rise toward the north. It is certainly surprising, at first sight, that the former shores are not "square with the world." But it is not at all surprising that no one discovered the fact until 40 years after the shores themselves were first recognized. This is because no matter how hard you look at the beaches themselves you can't *see* the tilt. The amount is too small to be perceptible within the mile or so of distance that the eye can encompass in a single view. But although an inclination of 2 feet in a mile is too slight for the eye to observe, a beach having this inclination will rise 100 feet when followed northward for 50 miles. With longer distances the rise becomes more striking. A beach that is only 40 feet above Lake Michigan rises, as it is followed 130 miles north to Sault Ste. Marie, Ontario, to 400 feet above this level. Its average inclination between these points is 2 feet, 9 inches per mile.

Several decades of patient work with surveying instruments have resulted in fixing the positions and altitudes of most of the shore lines. The water surfaces of the present-day lakes are like gigantic spirit levels, for they form angles with the old shores that rise northward. As it is obvious that the old shores must have been level at the time they were made, something must

▼ As THE LAND ROSE with the retreat of the Glacier, seacoasts were also affected. Here an old beach, 100 feet above the present one, is visible continuously from left to right. The broad step in the headland at the left was cut out of hard rock by storm waves when it lay at sea level. Trout River, Newfoundland




Present-day shores of Great Lakes.
Limits of additional area covered by lake water while the ice sheet melted.
Abandoned outlets.
Present-day outlet.

▲ THE GREAT LAKES were formerly much larger, as shown by the outer line. Niagara Falls has not always received their overflow. At various times since the retreat of the Glacier, the lakes emptied into the Gulf of Mexico, the Atlantic Ocean near New York City, and Hudson Bay

have deformed them since then.

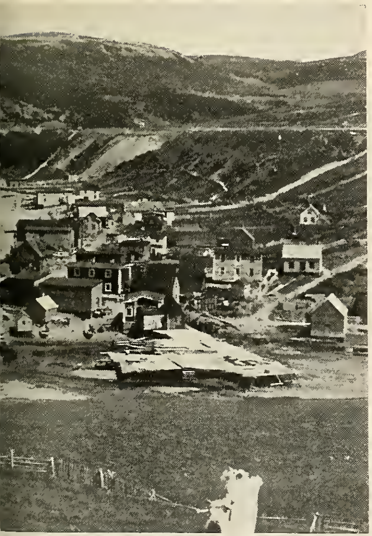
The deformation is not confined to the Great Lakes. To the west, as far as the Great Plains of Canada, there are other tilted-up shores of former ice-dammed lakes. To the east, in New York and New England, there are more tilted-up lake shores. And along the Atlantic coast itself, through New England, the Maritime Provinces, Newfoundland, and Labrador, old shore lines made by the sea itself are tilted up. Some of them are terraces sawed by breaking waves through hard bedrock, and many of them contain the fossil remains of marine animals. In eastern Canada some of these shore lines reach as far as 700 feet above sea level, and in their sands and clays have been found marine shellfish and the bones of whales and seals.

A Giant Bulge

Throughout this whole northeastern part of North America, the tilted shore lines fall into a definite pattern, in which there are two elements. The first is that the area of tilted shore lines coincides pretty closely with the area covered by the former great ice sheet. And the second is that the direction of uptilting, regardless of the location of the shore line, is toward the Hudson Bay region, which was the center of the ice sheet when it was thickest and most extensive. When we remember that the lakes did not exist until the ice had started to melt away, all this looks as though the tilting had been closely connected with the ice itself.

And so it was. Hudson Bay lies at the center of what was once a gigantic depression in the solid surface of the earth, a dimple with a diameter of 2000 miles. If it were not for all those shore lines, each of which was originally horizontal but is now bent upward toward Hudson Bay, we would not know that the dimple was ever there. When the massive ice sheet lay on the ground, its vast weight "pushed in" the earth's surface, and when the ice melted away, the pushed-in area—a broad saucer-like depression—was gradually erased as the ground bulged up toward its original position.

Richard Foster Flint photo



Rock that Flows

At first sight such a picture of flexible ground does not seem to make sense, for we can all see that the rock at the earth's surface is very brittle and quite unbendable. However, its brittleness is deceptive. We all know that the materials we use in daily life bend before they break; why should not rock? Of course, it does. To produce the effect just described, each foot of rock only had to bend scarcely one-one hundredth of an inch, if indeed it did not break a little here and there. But what, you may ask, was going on underneath? A relatively short distance beneath the surface, the rock is not brittle at all but instead is weak and bendable. The weakness is the result of the tremendous pressure exerted upon the rock by the sheer weight of the rock that overlies it. The farther below the surface we go, the greater the pressure becomes. When it reaches something like 150,000 pounds per square inch, the rock has become so weak that a slight push in any direction will make it flow like dough or putty. In short, the rock is plastic. And it stays plastic only as long as it is under at least that much pressure—a pressure three times as great as the pressure inside a modern howitzer at the moment it is fired.

So the weight of the overlying rock—a layer many miles in thickness—keeps the rock down below in a plastic state, all ready to flow as soon as it is given an extra push. But we are dealing with things on a big scale, and it takes something pretty large to provide the push. For that something a big ice sheet, 2000 miles in diameter and anywhere from 1000 to 10,000 feet in thickness, will do very nicely. Built of atmospheric moisture in the frozen form we call snow, an ice sheet constitutes an unusual and extra load on the earth's surface. A big ice sheet 5000 feet thick adds another 2000 pounds per square inch to the pressure beneath it. That is the extra push. Take a pound of margarine in one of those transparent bags that distribute the coloring matter through it. At ordinary temperatures the margarine is stiff and does not flow; it holds its shape. Now press your thumb slowly into the middle of the bag. The pressure of your thumb is the extra push necessary to make the stuff flow—away from your thumb where the pressure is greatest, toward other parts of the bag where the pressure is less. This is what happens to the plastic rock material many miles down when the ponderous glacial thumb presses upon it. The only difference is that when your thumb is removed, the margarine, being under no extra pressure, stays where it is; it does not "recover," whereas the deep earth substance, being still under pressure from all the rock on all sides of it, flows back again as the glacier melts.

It is evident, then, that the "bulge" that tilted the shore lines is not something new. It merely wiped out a broad dimple that was temporarily impressed in the face of the earth, bringing the surface back to where it was before. *Terra firma* is certainly a misnomer for the ground we walk on!

Putting the Story Together

Our tilted shore lines have got us into some pretty deep water, but with our picture of a margarine bag firmly in mind, let us try to reconstruct what occurred. First, with a chilling of the climate about 100,000 years ago, the winter snowdrifts failed to melt during the summer, and little by little the accumulating snow formed vast glaciers, one of which spread over the whole northeastern part of North America, reaching its greatest size about 60,000 years ago. As it spread, its great weight depressed the ground beneath it, until in places the ground had sagged as much as 2500 feet. This seems like a tremendous depth; yet when we recall that the radius of the sag was 1000 miles, its average slope could have been no more than 2½ feet per mile—too slight an inclination to be seen by the eye.

Then the ice began to melt. Along the coast the sea filled in areas as fast as they were vacated by the wasting glacier. Inland, water from the melting ice was caught between the edge of the glacier and the ground that sloped toward it. Around the lakes thus formed and along the sea, storm waves dashed against the shores and cut cliffs, and longshore currents built beaches and bars. As each lake basin filled with water, it overflowed, and thus were cut the great river channels, now dry, such as the one in which Chicago made its canal.

As the glacier melted and grew thinner, its weight upon the ground diminished and the vast saucer it had pressed for itself began to get smaller and shallower. In this process, the horizontal shore lines that wave and current had inscribed upon the land were slowly bent up toward the center of the saucer, where the wasting ice still lingered in the Hudson Bay region.

The change was a slow one. The lakes began to be formed about 35,000 years ago, and the unbending has been going on ever since—throughout a period more than 100 times greater than the time that has elapsed since the Pilgrims landed at Plymouth Rock. The ice disappeared from the center of the saucer perhaps less than 10,000 years ago, but the saucer is not fully erased yet. The determined upbending is still going on around Hudson Bay, creating a fantastic collection of abandoned shore lines in the process; and it still has 600 to 800 feet to go before the ice-made depression will have been completely obliterated.

A Look into the Future

"Wait a minute," says someone. "Was that figure 600 to 800 feet? But how deep is Hudson Bay? Mostly less than 500 feet, isn't it? Well, then won't it . . .?" Quite true; it will become dry land. Moderately dry, at least, for all the rivers that now flow into it will gradually have to lengthen at their mouths until they join to form a single trunk stream with its outlet somewhere near the western end of Hudson Strait—or Hudson Inlet, as it will have to be called then. All this is going to make our present-day maps of North America quite obsolete, for our continent will have lost its one big inland sea.

The outermost parts of the great dimple seem to have been erased already, and in the Great Lakes region slow downbending toward the southwest is now going on. Whether this movement is connected with the ice sheet or has another cause is not know. But whatever the cause, the northern shores of Ontario, Huron, and Superior are nearly stable, whereas the southern shores of Superior, Michigan, and Erie are sinking at a rate of more than one inch every ten years! This movement is measured accurately by Government water-level gauges and is independent of the rise and fall of the water surface with which we began this story. Its effect is to deepen all southern harbors such as Chicago, Milwaukee, and Cleveland while leaving those in the north almost unchanged.

If this movement continues, it will have one remarkable consequence. Unless some kind of dam is built at Chicago, the sinking there will make Lake Michigan spill over once more and send its overflow into the Mississippi River. The small controlled overflow that already goes that way through the canal could in time grow into a really big river. Whatever water flows out past Chicago robs Niagara Falls of an equivalent amount; so there is plenty of material in the situation for a big legal argument.

TO FIND
Wild Honey

One hundred pounds of it in one tree! But the thrill of observing the marvelous creatures that make it may be richer reward than the golden treasure

By Arthur C. Parsons

Photographs by the author

▲ THIS BEE'S home is in a hollow tree near the heart of our nation's capital. But the serious hunter of wild honey will be lured into woodlands he might never have thought of visiting

HAVE you ever seen a swarm of bees pass overhead on a warm day in the spring—a buzzing, humming swarm which resembles a rapidly moving smoke cloud that soon disappears into the distant forest? Or have you ever seen a swarm forming a dense cluster two or three feet long on the branch of a tree? Have you wondered where they came from and where they are going? Every beekeeper knows the answers, of course, but those questions were answered for me by the bees themselves some years ago.

◀ SPORTSMANSHIP among honey hunters. The procedure is to carve one's initials in the bark so others will know that someone else discovered it first

One warm afternoon in May, I was photographing some of the different types of ferns in a pasture when I noticed some honeybees coming and going through a small hole in a dead black cherry tree. The hole was only some four feet above the ground, so I was able to observe them easily. There were so few of them that it was obvious that no wild swarm occupied the tree as yet. Apparently they were merely exploring the possibilities of the tree as a new home; but at the same time, they were busily engaged in removing wood chips, sawdust, and other debris from the cavity. A few days later my assumption proved correct. A large swarm came from a gnarled old cherry tree about 500 yards away. This old tree had been occupied for about 20 years by a swarm of Italian bees that had escaped from an apiary in the neighborhood. Many people knew of this swarm and had wanted to cut down the tree to obtain the honey, but because it marked the boundary between two properties, the owners had refused permission. Now the swarm hovered in the air for some time and then settled on the limb of a nearby maple for about an hour. Taking flight, it headed in the direction of the tree in the pasture, and when I arrived about half an hour later there was a huge cluster of bees around the entrance to the hollow. They prospered there for five years before bee hunters found and cut the tree.

What prompted the bees to depart from their established home? When a beehive or bee tree becomes too crowded, when there is not enough space for the bees to store a sufficient amount of honey to sustain the colony through the winter months, the bees provide a new queen for themselves by constructing large, more or less cylindrical "royal cells." The grub that develops from the egg laid in such a cell is provided with "royal jelly," a special food secreted by the worker bees and fed to the bee that is to develop into a queen. When this new queen emerges, the old queen and part of the swarm leave their hive to seek a new home in a hollow tree or some cavity, leaving the old home to the new queen and the brood she will produce.

Preparing the new home for occupancy is no easy task. The explorers who found the hollow merely started the work. The hollow must be cleaned out thoroughly. All dust and chips must be removed, cracks must be sealed against the weather and possible enemies, and, most important of all, new comb must be made at once for brood and for storage of honey for the cold months to come.

To make the comb, the bees form a chain from the top of the cavity. Each worker has plates on the underside of her abdomen on which the wax forms. They scrape the wax off and use it to build the comb. So, in a few days, there are cells in which the queen can deposit her eggs and in which the workers can store their honey. If the season is good, more comb will be built, for the bees never cease to work as long as there are flowers from which to gather nectar and space in which to store it. When the comb is first built, it is water-white in color. With age it becomes yellow and finally dark brown or black. The same comb is used year after year, but it does have to be repaired from time to time.

Hunting wild bees has been a popular autumn sport in some parts of the country ever since the colonists brought the first bees and permitted some of them to escape to the forests. Bee hunters seem to get the same thrill from locating a bee tree that hunters do from bringing down a ten-point buck or fishermen from landing a fighting trout or bass. In many cases, too, a winter's supply of honey for sweetening has been the incentive for following the bees to their home in a hollow tree.

Several methods are used in locating the forest homes of wild bees, but probably the most popular is the use of the bee box. This is simply a wooden box approximately the size of a cigar box, fitted with a glass top that slides in grooves. A hole about one inch in diameter is made in one end, through which the bees can enter and leave. A slide is fashioned so that the hole may be closed if the hunter wishes to imprison the bees for a short time. An old piece of honeycomb about four by six inches completes the outfit. The bait to attract the bees is honey or sugar syrup, which is poured into the cells of the comb.

On a warm autumn day when the frosts have stopped the honey flow and the bees can easily be attracted to the bait, the box is set up on a stump or stand in a field near the woods. Now a piece of comb is burned or a few drops of oil of anise are poured on the stump to attract the bees. If there are any wild bees in the immediate vicinity, the first one will usually appear within a few minutes. As soon as she locates the comb filled with honey or syrup, she drinks her fill, rises, circles slowly in order to locate her home, and then makes a "beeline" for it. We need a quick, sharp eye to follow her line of flight. In a few moments she will return, and in a brief time two or three of her fellow nectar gatherers will probably also arrive. We should have a definite line established after we have watched them depart once more. The next step is to move the box two or three hundred yards to one side and get another line. The tree is located where the two lines cross.

Sometimes the bees have come from such a distance that the two

◀ Honey from an oil well! The hoard was discovered in the vertical Samson post of this abandoned well

➤ AN INCONSPICUOUS HOLE the only sign. Comb extends above and below the hole in this maple in western New York State

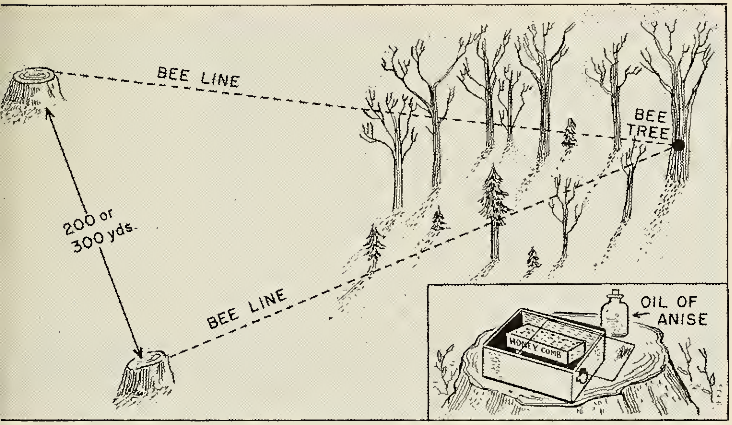
lines are not easily distinguished. It may then be necessary to follow the bees for some time. So we keep some of the bees in the box by means of the glass cover and the stopper over the hole at one end. We release the bees at intervals of a quarter of a mile or so. As we get closer to the tree, the bees become more numerous. A hundred or more of them may be fighting for a place on the comb in the box. A pair of good field glasses or binoculars is now a help, for with them we can examine the trees ahead and possibly locate the entrance to the hidden store of honey.

This is a reliable and tested method of finding a bee tree, but you will have to use patience at the beginning. And do not be surprised if you follow the bees straight into a farmer's hive. Many an experienced bee hunter has done just that.

When the bees are rearing their brood during the summer months, some of the members of the colony assume the duty of water carriers. They locate the nearest supply of fresh, clear water, preferably where there is sand or gravel on which they can perch while absorbing their supply of moisture. If you can find the watering place, finding the tree is easy. Bees are rarely far from good fresh water, so you may rest assured that you are near the tree. One summer I located four trees just by watching the bees fly away from roadside springs in Virginia and Pennsylvania. All four trees were visible from the highway.

The third method of finding wild bees might be termed the accidental method. For example, last summer I located five swarms while driving along the highways of western New York and northern Pennsylvania. One was in a sugar maple, one in a white pine, one in a hemlock, one in a locust, and one in the partition of an unused barn. Old bee hunters say, "Always look for wild bees in a maple; they hollow out easier," but they may locate in any kind of tree if the cavity is large enough. I examined the swarm in the building by gently prying loose a board on the inside. The combs were almost white, showing that the bees had moved in that spring; and they were almost filled with honey, although the goldenrod flow had not yet started. I put the board back without removing any of the honey or further disturbing the bees. At other times I have accidentally found wild bees while wandering through the woods in search of pictures of plants or animals.

Perhaps I have used the word "tree" too loosely in the preceding paragraphs, for wild bees will make their homes in the most unexpected places. Any cavity large enough to hold a sufficient amount of honey for the winter will be utilized. One swarm moved into a chimney during the warm months and was not discovered until the first fires were lighted in late October, when a rain of dead bees fell into the fireplace, along with a steady drip of sticky honey. Another swarm has occupied the six-inch pipe of a gas well derrick in Pennsylvania for some years. Soundings are said to show that the comb extends some 20 feet down the pipe. Need I say that the employees climb that derrick only during cold or rainy weather? We have found them in the Samson post of an oil well, between the studding in buildings, in an abandoned box trap once used to catch rabbits, in stumps and logs, and between the shutter and window of a hunting camp. The latter made a perfect observation hive. A swarm in Washington moved into a hollow metal post supporting a fire alarm box, and another was said to occupy the



◄ A DEAD WILD CHERRY tree that yielded 40 pounds of honey and comb. No tree should be felled without the owner's permission and a reasonable share of the honey. Many leave the bees to starve. These were hived and kept over the winter as they should be

▼ ONE OF THE COMBS has just been removed, and the hunters are scraping the bees and wood chips from it. The bees from this hive are now working for a farmer

forearm of a statue in Richmond. Still another swarm chose the drawer of a bureau that had been left on the porch of a Maryland farmhouse. One more swarm in Maryland could not find a hollow, so it built its comb outside against a tree trunk. Wild bees, then, are like gold—"It's where you find them that counts, not where you look for them."

Wild bee hunters are somewhat like fishermen in that they often tend to exaggerate their catch. Rarely does a bee tree yield less than "a washtub full of honey." You hear of "half a dozen buckets and a dishpan full" or "all the pans we had in the house and then some" or "more than a hundred pounds." Actually, the amount of honey depends upon several factors—the size of the cavity, the strength of the swarm, the number of years the bees have inhabited the tree, and the weather during recent seasons. When the swarm moves in, the bees have to build comb, and between seven and twenty pounds of honey are said to be necessary to make one pound of comb. Thus if a small swarm moves in late in the season, some comb will be made, but there will probably not be time enough before frost to fill that comb with honey. The bees, of course, will starve during the winter. I have seen trees cut that had comb but no honey, and I have seen others that had 100 pounds by actual weight. The average yield is about 40 pounds. However, an apiculturist with the United States Department of Agriculture informed me that there are records of trees yielding several hundreds of pounds.

The quality and type of wild honey will vary considerably according to location, climate, and the number of years the bees have occupied the tree. Usually bees are temporarily constant to a single species of flower, but each comb may contain a mixture of apple, wild cherry, tulip, basswood, clover, buckwheat, goldenrod, and many other flavors depending upon the part of the country in which it is found. The new comb will vary from water-white to light yellow, and the old comb will be black and tough. The comb is usually broken open when the tree is felled, so that the honey is mixed with brood, dead bees, sawdust, chips, and dust. Consequently, it has to be strained before it can be eaten. Nevertheless, many people like the mixed flavor—so many, in fact, that some bee hunters make a business of selling the product in small jars at fancy prices. Personally, I like one flavor at a time, and I prefer that in comb honey taken from a professional beekeeper's hives.

The honey is usually strained by placing the crushed combs in a muslin bag and hanging it above the kitchen stove. The heat melts the wax capping of the cells, and the honey drips through the bag, straining out whatever foreign matter there may be in the comb. The beeswax is also preserved, either to be sold or to be used for waterproofing footwear, to make flatirons glide more smoothly, or to use on thread.

Any beekeeper can tell you that his charges require constant attention. He must protect them from rodents, larger animals, and diseases such as American or European foul brood, which can decimate a colony in a short time. Because wild bees do not enjoy that protection their chances of survival are proportionately less. Death of or injury to the queen may cause the colony to die out. Foul brood is always a danger. In fact, many commercial beekeepers advocate the destruction of wild bees because they cannot be controlled and may serve as a source of infection. However, surveys have indicated that there is no more than one or two per cent infection among wild bees. I have never found foul brood in a bee tree, but I do know of one infected swarm taken from a church steeple in Maryland. Mice, rats, and squirrels will disturb the bees if they can gain entrance to the honey combs. One swarm between the partitions of a barn was raided so often by rats that it finally left. The rats gnawed the combs so that there was a constant smear of honey on the boards.

Some of the larger animals, especially bears and skunks, are destructive to wild bees. The bear's liking for honey is well known; it will risk almost anything to get at a store of sweets. I found one swarm of wild bees in an old white pine stump, but when I returned to examine it, there was nothing but splinters, broken comb, and angry bees buzzing around. The bears had found it and had eaten all the honey. On one occasion I watched a bear attempt to break into a gnarled old maple that had long been the home of a swarm. He was clinging to the tree with three legs and trying to claw an opening into the store of honey with his free paw. Every moment or so he threw his head back and wiped the bees from his vulnerable nose. The bear's fur is so thick that the bees cannot penetrate to the skin, but his nose is tender. Finally he gave up and backed down the tree. Then he looked up at the branches in utter disgust and ambled away through the timber.

Skunks will disturb bees if the entrance to the tree is low enough for them to reach it. One swarm of bees was entering an old white pine about two feet above the ground. One evening I saw a skunk approach the tree and scratch around the knothole. Immediately the bees boiled out to repel the intruder, but he stood his ground. When he had several bees in his fur, he calmly began to pick them out with his teeth. Apparently the skunks like the acid taste of the honeybee.

The chief enemy of wild bees, as of other wild things, is man with his ax and saw. All too often he cuts the tree to obtain the honey and then burns the bees to prevent their coming to his bee box when he hunts further. Sometimes he kills the bees with sulphur smoke before he attempts to open the tree. That procedure saves him a few stings, but it may scent the honey. He may cut a block out of a tree early in the summer, remove what honey there is, and then leave the tree open to invasion by other enemies. These practices, of course, reduce the number of bees, which supplement the activities of our native bees in fertilizing so many of our domestic wild flowers and trees.

Some years ago almost every farmer had a hive or two of bees tucked away in the corner of the orchard. The bees helped to fertilize the blossoms of his fruit trees and other crops, and the sale of honey added a few dollars to his cash income. Because farm labor is so scarce or because mechanization has made so many one-crop farms, the bees have to some extent been given up. Commercial beekeeping on a large scale has, it is true, increased for some years, but here, too, a slight decrease was noted in 1948. Wild bees, on the other hand, seem to be increasing somewhat where second growth timber has become large enough to harbor them. I suspect that a census of wild bees would show that they are far more numerous than we have ever imagined. For example, I set up a bee box in my back yard in a residential section of Washington, D. C., and within an hour bees from four different swarms were carrying the honey bait away. It might be thought that they came from bee enthusiasts in the city or from outlying rural districts, because bees will travel several miles from their nest. But two of the bee trees were located in the vicinity of the zoo, a third was back of a famous hotel, and the fourth, we believe, was near the estate of a legation, although it was not located exactly because cold weather caused the bees to cease working. If there are four trees in this vicinity, there must be many more in the parks and nearby woods of Maryland and Virginia.

Since bees are so essential to the fertilization of our agricultural and forest crops and since the bees are disappearing more and more from our small farms, I believe that we should use greater judgment in the cutting of bee trees. If we must cut the tree to see how much honey is inside, at least let us hive the bees and feed them through the winter so that they may work for us during the following summers. Whenever bees are killed or left to starve there will be two swarms less next year, for each one would have divided at least once. If the tree in which the bees live is a good solid one except for the hollow limb containing the comb, or if the tree marks a corner or boundary between farms, leave it as a source of supply of other swarms. We will profit in the end through better crops and flowers.

All too frequently the bee hunter looks upon a bee tree as his own private property regardless of who the real owner may be. I know of at least two fine maple trees that were cut on the property of a water company. That property is also a state game preserve, and both the state and the water company had "No Trespassing" signs attached to the wire fence surrounding it. Apparently there are some people who cannot read, especially on a dark Saturday night in October. The trees were left to rot while the bees were left to starve. No bee tree should be cut without the permission of the owner, and he should be given some choice combs for his kindness.

Sometimes when the bee hunter finds a nest that has not yet reached its peak of honey production, he will "stake his claim" by marking the tree so that other hunters will know of his prior discovery. It is interesting that certain Indians in Paraguay and Mexico are also known to use property marks in the same way to establish their right to wild honey, as mentioned by Herbert F. Schwarz in his recent monograph on stingless bees.

"To the farmer the honeybee is worth fifty times the honey she produces," someone has said. Let us protect the wild bees, or, if you wish to eat wild honey, at least preserve the bees in a hive. That is only common sense.

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Natural History
CRYPTOMAZE

FISHES *By* EDWARD DEMBITZ

PART I. In this puzzle you are given a set of definitions, each with a set of blank spaces, and a diagram to be filled in. Each definition is a clue to a word whose letters you are to insert in the blank spaces preceding the definition. These words appear in recent issues of NATURAL HISTORY Magazine.

	8	9	4	22	16	12	23	*Mossy area—a source of fuel, and sometimes used as a refrigerator (2 words)*
		14	15	12	11	19	5	*Plant whose leaves form exclusive diet of Great Spangled Fritillary caterpillar*
18	15	4	22	13	25	20	17	*Genus of ostrich-like birds that lived in Wyoming about 50 million years ago*
			8	24	15	10	25	*Roman naturalist (A.D. 23-79) who gave many plants their present names*
22	17	7	6	15	10	15	18	*A kind of fly whose larva is the chief enemy of the monarch butterfly*
		21	1	11	5	7	6	*Material laid down in oyster farms as points of attachment for spat*
				2	1	10	23	*Dynasty during which Chinese domesticated the goldfish*
		4	20	12	9	16	17	*One of the simplest known animals, named from the Greek "to change"*
14	19	13	12	10	15	21	17	*Widespread genus of herbs; also called the speedwells because of their brief blooming*
			2	3	15	10	3	*A reptile. One letter keeps it from being a harmless mammal that everyone fears*
	2	4	24	12	20	12	10	*Given name of Swedish engineer lost in arctic balloon flight in 1897*

PART II. When you have filled in all the letters above, transfer them to the proper numbers in the boxes in the diagram below.

When the diagram is completed you will have a word maze which contains at least 31 names of FISHES of the world. To find one of these fishes, begin with a letter and move from space to adjoining space in any direction, including diagonally, until the name is spelled out. **You are not permitted to form double letters by jumping up and down on the same square.**

Copyright 1949
By Edward Dembitz

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

THREE PRIZES. *The three contestants submitting the largest number of names of fishes fitting this puzzle will each receive an autographed copy of* NORTH AMERICAN GAME FISHES *by Francesca La Monte, a well-known handbook published by Doubleday, Doran and Company.*

Names of fishes must appear in bold-faced type in the main A-Z section of Webster's New International Dictionary—*1948 (unabridged) in order to be eligible. Names in bold-faced type below the line at the bottom of the page are allowable. Different names for the same fish will be accepted. So will variants, alternative spellings, and scientific or technical names, providing they appear in bold-faced type. Flagrant disregard of the rules will disqualify a contestant.*

In case of ties, duplicate prizes will be awarded.

Entries must be postmarked on or before May 1 and be received by May 6, 1949.

Winners and their scores will be published in NATURAL HISTORY *for June 1949.*

The contest is open to everyone except employees of the American Museum and the Doubleday Company and their families.

THE MAN WHO GRABBED A SHOOTING STAR

Continued from page 167

interested spectators, too: the huge meteorite was a prize plum for the lucky museum that could first conclude a deal with the owner. But —who was the owner?

The lawyers for the iron company discovered at this point, with much satisfaction, that a similar case had been tried in Iowa in 1890. A zealous Iowa professor had rushed in and bought a meteorite stone—a small one—that fell in a field. He bought it, unfortunately, from the man who dug it up and not from the man who owned the land where it fell. The Iowa court ruled that the meteorite was *part of the land.* This made things look very bad for Hughes, since courts are notoriously respectful of established precedent. But Hughes' lawyers were not done fighting.

No one had seen the giant Oregon meteorite fall; no one knew how long it had lain in the wet forest, but obviously it had been there for quite a while. Hughes' lawyers simply argued that the great chunk of iron was an Indian relic. They brought forward Indian witnesses who testified that the meteorite had been worshipped and looked after and generally treated with the respect that white men accord important personal property. And Indian relics, by established law, are discarded personal property and belong to the person who finds them.

It was a good argument, good enough to give the opposing counsel a bad time until the verdict was announced. But again Hughes lost the decision. His own industry and intelligence in moving the meteorite had cost him the case. The court ruled that if a white man, enjoying the mechanical resources of civilization, had had that much trouble moving the thing, the Indians could never have moved it and made it their personal possession, and so it must have remained a part of the land!

While the legal tug-of-war was in progress, the American Museum of Natural History, eager to acquire the scientific treasure, opened negotiations with both Hughes and the Oregon Iron and Steel Co. When the Court decided in favor of the Company (on July 17, 1905), negotiations continued with the established owner, and after a half year of offers and counter-offers, the Museum finally purchased the meteorite for $20,600. Today it rests on display at the Hayden Planetarium.

Legally, in the United States, meteorites now belong to the person upon whose land they fall. But the skill and daring of Ellis Hughes still excite occasional doubts in admiring legal minds. For old cases have lately been found in Europe in which the courts held that meteorites could not possibly be part of the land but belonged to the first finder!

Perhaps someday the situation in America may be changed by legislation. The scientists who specialize in shooting stars would like to see all meteorites become public property, with the finders liberally rewarded. Meteorites are that rare—and that important to science.

Winners of the Western Hemisphere Bird Cryptomaze in the February issue of NATURAL HISTORY: The three contestants submitting the highest number of birds listed in the main section (A-Z) of *Webster's New International Dictionary*—1948 (unabridged), in accordance with the rules of the contest, are: DR. HENRY S. RICH, Bronx, N. Y. —44 birds; RICHARD G. BEIDLEMAN, Fort Collins, Colorado—39 birds; AL ANTHONY MANTOVI, Staten Island, New York—33 birds. Each of these winners has received an autographed copy of the *Audubon Bird Guide—Eastern Land Birds* by Richard H. Pough, published by Doubleday and Company.

Technical or scientific names of birds were counted only if they appeared in bold-faced type. Scientific opinion favored the inclusion of Hawaiian birds as being of the Western Hemisphere but not birds from regions west of there. Variant spellings of the same name were not counted, but different names for the same bird were. In a two-word name it was not permitted to use two points of departure.

AMONG THE TURKANA

Continued from page 159

the dance that was readily understandable to us. At first it consisted mostly of jumping and chanting, the men bobbing stiffly up and down and alternating their jumps with those of the women who faced them in line. The monotonous chanting would continue for a time and then die down into comparative silence, after which it would begin again. The dancers did not confine themselves to this pattern exclusively, however. Presently they began their Elephant Dance, which must have originated long ago, for elephants are no longer found in this region. In it, the men formed a curving line, each waving one arm in sinuous imitation of an elephant's trunk. Now and then, in the more active periods of the dance, the men—who alone took part in this movement—rushed at the women, who surrounded them, laughing and swaying; and then everyone would shout excitedly. As the women moved about the men, they coquettishly flipped up their goatskin aprons in the men's faces. The children ran and jumped beside the dancers, but no attention was paid to them, and they came to no harm.

Neither did the dancers cease their now almost continuous rhythmic jumping nor offer objection when Mr. Whitehouse took us directly in among them for a close-up. Actually, they pushed one another aside so that we could see into the middle of the circle, which had then been formed by the dancers holding hands. The performance seemed to be some odd version of our own children's game, "Farmer in the Dell." A man, stamping, jumping, and darting about in the ring, would choose a woman and pull her in beside him. She, in turn, dancing about, would grab a male partner to the accompaniment of much yelling and laughing as they all pushed one another about. Though all appeared to be violently excited by that time, the Turkana remained both polite and considerate as far as we were concerned, and we enjoyed the fun.

As darkness fell, the dance grew wilder and began to take on such erotic characteristics that Mr. Whitehouse tactfully suggested it might be best to return to his house. There, after a late dinner, we climbed the stairs to the flat roof where we could relax in comfortable deck chairs. From this vantage point we looked off across the desert-like country, so fascinating in the strangely white equatorial moonlight. We talked of these people, now so friendly, once so warlike. Off in the distance, with their fires still glowing redly through the night, the Turkana were going on with their dancing and shouting. And even when we had thanked our host and returned to camp, the dance continued. As we fell asleep we could still hear the faint and rhythmic native cadences.

Throughout the length and breadth of Africa the forces of civilization are constantly at work, changing the ways and ideas of the natives. But in northwestern Kenya the Turkana see little of these changes, and they are decidedly resistant to such forces as have come from beyond their own borders. They seem likely to retain their habits and customs longer than many other tribes; yet, in time, no doubt even they will change.

The material collected by our expedition and brought back to the American Museum of Natural History shows a cross section of the life of the Turkana of today, and in view of the inevitable alterations the years must bring, we believe the collection will become increasingly valuable. And we know that the experience of visiting the Turkana was a privilege we shall never forget.

DISCOVERING NEW ZEALAND

Continued from page 179

ried back with them to camp. We worked the clay till it was malleable and then pressed the leaves to be molded down onto it so that all the contours were in natural form. Little walls of clay were shaped around the edges to hold the plaster we poured on the leaves. We made it of the consistency of fudge frosting when you spread it. When firm, we did the same thing to the other side of each leaf. Bob had not made such molds for 40 years, and I had never made them, but they came out well for use by the preparators at home.

There were long lists of last things to do. I sewed up samples of the beach in cheesecloth—driftwood and all. We laid burlap bags on the forest floor and filled them with dead leaves and twigs and debris. Think of the meticulous care put into the creation of a museum habitat group, sending stones and dead leaves half around the world! Bob cut bundles of sedge, and I tore fibers off flax leaves to tie them with. We caught the final pictures—red berries of the supplejack, red leaves of the pepper bush. We clambered over the rough track for the last time, the supplejack living up to its Maori name, tataramoa, which means something like trip-up-moa. Once I reached my hand to a tree trunk for support and was pricked by thorny lawyer. Near the camp, the track was smooth. Such beauty of gray-lichened trunks—gray warblers passing—bellbirds calling. Such hurt always to be leaving what one has loved so much.

Yet there were compensations! We left our itching, too! There are several itchy insects in New Zealand. You think you are relaxed and have mental control of such an absurd torture, when whiz!—a wave of it sweeps over you and all your nerves are taut. Insect repellent should come in gallons, not in ounces.

The last sketch was made and the last picture taken. The last careful package was ready. "Tikinui" came.

But we had no rata. We could see the scarlet bloom on the eastern mountains, but no one had been able to get at it for us.

As we walked up the Te Kinga road, all the townsfolk greeted us by name, and a child ran out and gave us flaming rata flowers. The Group holds everything you need to see to know New Zealand as it was before men invaded its primitive perfection with their thoughtlessness.

CONSERVATION

Continued from page 146

the problem presented by the private holdings that lie scattered within some of our finest National Parks. The Park Service has no control over the uses to which the private owners of these lands may put them, no matter how out of keeping these uses may be with the character of the surrounding park land. This year the Department of the Interior budget contains an appropriation of only $300,000 for this purpose. At this rate it will take over 65 years to buy up these lands at present prices. Every year the value of the lands increases, and delay only increases the ultimate cost. In view of the millions of people who visit our National Parks annually, $5,000,000 a year would be a much more reasonable amount to appropriate at this time.

These are only a few examples of the way conservation interests are being short-changed year after year. If you think conservation problems should be given more consideration, it is up to you to let your Congressman know at once how you feel, and in this case it would be advisable also to send a copy of your letter to The Honorable Clarence Cannon, Chairman of the Appropriations Committee of the House of Representatives.

Another example of our penny-wise, pound-foolish policy comes from the field of research. Congress years ago authorized a research vessel for the Fish and Wildlife Service, to enable it to start filling in the enormous gaps in our knowledge of our marine fishery resources. After Congress failed for five years to make good on this authorization, a private corporation finally gave a research vessel, the "Albatross III," to the government, and now it is lying idle for an appreciable part of each fiscal year because of inadequate appropriations for its maintenance. When one realizes that many foreign governments are supporting several such research vessels and that the problems they are concerned with are vital to the future of a resource that is yielding many millions of dollars worth of food annually, the shortsightedness of such economies is quite obvious. There is little doubt but that the research that this vessel could carry on during the months when it is lying idle would pay for itself many times over through increased yields based on better fishing practices.

Richard H. Pough,
Curator, Conservation and Use of Natural Resources,
American Museum of Natural History.

May NATURAL HISTORY *1949*

Land of the Caribou • Haida Carvers • The Big Bend

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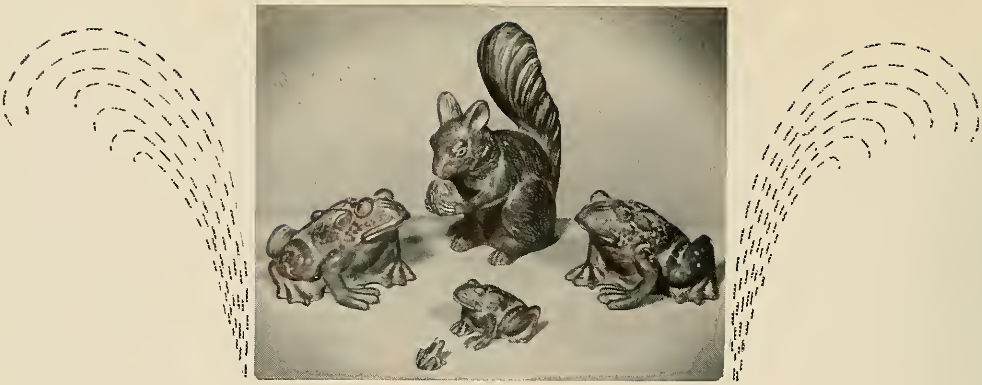

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LETTERS

Armadillos on the Increase

Sirs:

I am much interested in the letter regarding the spread of the armadillo in Florida in last month's Natural History.

I took a Kodachrome picture of an armadillo in Melbourne, Florida, in January, 1939. At that time it was rare and considered a curiosity. This January and February I saw two dead ones on the highway near Lake Washington and one about twelve miles west of Melbourne, also one alive on Merritt's Island. Friends have reported seeing them within one to three miles of Melbourne in different directions. No doubt about an increase in the past ten years.

J. M. Hollister.

Melbourne, Fla.

Baby Snails

Sirs:

My sister has a five-gallon aquarium in which she keeps three goldfish and a fresh-water mussel. On February 26, she bought a snail, which five days later presented us with eleven babies. The next day there were six more, and on March 5, three, making a total of twenty. Each was born complete with shell and was about the size of a small pea.

The only book I could find has an illustration of a snail similar to ours and calls it a Japanese snail. The book says that the snail may be either male or female and that the female, once impregnated, seems to remain fertile for the rest of her life . . .

Could you tell me more about their reproductive habits?

Ann Trainor.

Elkhart, Ind.

The following information is offered by Dr. Libbie Hyman, of the American Museum's Department of Fishes and Aquatic Biology:

Nearly all fresh-water snails have both male and female reproductive organs in the same individual, but some do not. Those that do not, usually have a little round shell on top of the foot, which they use to close the opening of the shell when they withdraw within it. If a snail has this so-called operculum, then, it is one of the kind that is either male or female (dioecious) but not both (hermaphroditic). In many cases, it is not possible to tell whether one of these dioecious snails is a male or a female. In other cases, the male has a very obvious male organ protruding on one side, shortly behind the head.

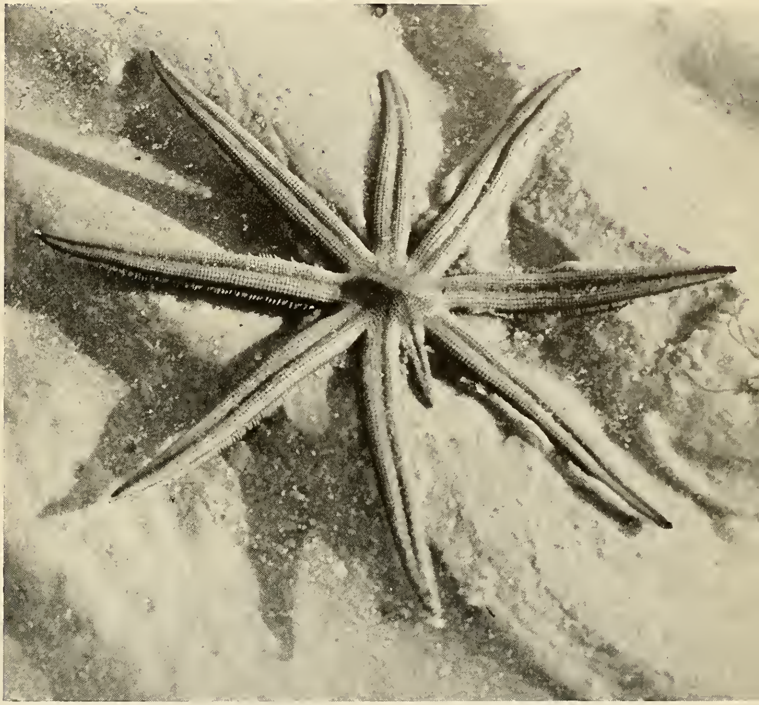
If Miss Trainor actually has what is called the Japanese snail, belonging to the genus *Viviparus*, the males can be distinguished by the right tentacle, which is short and thick. Apparently this difference can be detected even in newly hatched snails. Also, the male does not grow as large as the female.

It is said that mating occurs only once in the life of the Japanese snail, so that all of the young are the result of this mating. They are produced once a year, in spring or early summer, but it is usual for those of one batch to come in installments, as Miss Trainor reports.

This snail has what serves as a brood pouch in the space between its body and the mantle. (The mantle is the skin that lines the part of the shell that is free from the animal's body.) In this space the female lays its eggs, and they develop there to the point of being small snails. The presence of these young can be seen in mature females, thus providing another way of distinguishing the sexes, though it is only applicable, of course, to sexually mature individuals.

Most all snails have a courting behavior similar to that described in Natural History for February, 1947. They usually don't hang on threads as that one did, but otherwise the behavior is much the same. Although hermaphroditic snails can fertilize themselves, they mate just the same as dioecious ones do. In fact, the article in Natural History was about a hermaphroditic snail.

NOTICE—Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on these pages will be paid for at $3.00 each, with full credit to the photographer. Return postage must be included.



▲ The Nine-rayed Starfish *Luidia senegalensis.* This is the most easily recognized starfish of the West Indies, because nine is such an unusual number for a sea-star. This individual is growing a new arm to replace one that was lost. In life, it is a bluish or greenish gray. Photograph by Hugo H. Schroder

Junior to Senior

Sirs:

I would like to compliment you on the different and unusual subject matter that has appeared on your magazine covers, such as the January, 1949, issue.

I have never seen this magazine before. In grade school we had the *Junior Natural*

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History Magazine, which we enjoyed very much.

Your Magazine is one of the most interesting and factual (without being dull) that I have ever read.

Eleanor Hall.

Barberton, O.

Prints Can Be Bought

Sirs:

I am receiving Natural History Magazine and like it very much.

In your March number, on pages 104 and 110, you have two very nice African wildlife pictures. Is there any way that I can buy the two pictures? I would like to have them as big as the whole page.

. . . I am from South Africa myself, although it has been 45 years since I was there.

H. Leyer.

Seward, Alaska

A photographic print or enlargement of almost any illustration appearing in Natural History Magazine with the credit line "*AMNH photo*" can be purchased through the Photographic Division of the American Museum, provided it is for personal use. Copies of photographs otherwise credited cannot be procured. The prices range from 25¢ for a 4 x 5 print to $17.50 for a 30 x 40 enlargement, with many intermediate sizes. A price list can be obtained by writing to the Photographic Division.

Many persons find these enlargements attractive as Christmas gifts or birthday presents. There are additional charges for mounted enlargements and also for photographs that are to be used for reproduction. We cannot undertake to provide prints of illustrations not credited "*AMNH photo*."—Ed.

Adventures in Space in the Planetarium

What problems confront those who would explore the realms of interplanetary space? What do we know of conditions that exist in the upper reaches of the atmosphere and beyond? These are questions that will be seriously considered in the Hayden Planetarium during May.

Visitors to the Theater of the Stars will hear about the latest developments in rocket propulsion and the many problems of navigation in space beyond the earth. The possibility of a man-made satellite will be considered in all its phases.

At the same time, the lecturer will discuss the latest information concerning the moon and the planets, with special emphasis on the physical conditions they exhibit.

▲ Porpoise jumping for food in one of the stockade-pools at the Lerner Marine Laboratory at Bimini

NATURAL HISTORY

The Magazine of the American Museum of Natural History

F. Trubee Davison, President
Wayne M. Faunce, Vice-Director
In charge of Publications
Albert E. Parr, Director

VOLUME LVIII—No. 5
MAY, 1949

Indian Chief....................Cover Design
From a Kodachrome by Clyde Fisher

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Your New Books.................... 197

Last of the Haida Carvers....................Lyn Harrington 200
The satiny-black stone carvings of the Northwest Indians win the esteem of all who see them, but they represent a dying art

Tracks in Desert Dunes....................Raymond B. Cowles 206
Delicate patterns in the sand are the signatures of a host of desert creatures

"Treetops"....................Lt. Col. and Mrs. William J. Morden 213
From a unique inn tucked high in the branches of a wild fig tree, a panorama of African wildlife can be observed while you enjoy the comforts of home

Big Bend National Park....................Sidney Ross 216
A region rich in the remains of prehistoric animals and entrancing in its spacious scenic grandeur

The Persimmon....................Donald Culross Peattie 221
Its wood, if seasoned, ranks among our hardest and most specialized in use; the fruit, if ripe, is among our softest and most delicious

In Caribou Land....................Francis Harper 224
Exploration in one of the least known sections of Canada, where the timber meets the tundra

Beachcombers....................Lewis Wayne Walker 232
The snowy plover is a distinguished camouflage artist and a born master of diversion strategy

City of the Crooked Water....................Nell Murbarger 234
Like an oasis in a region of famine, the ancient settlement called Tuzigoot flourished, but its fertility seems also to have spelled its doom

Cryptomaze—Minerals....................Edward Dembitz 236
A prize puzzle

You will find Natural History Magazine indexed in *Readers' Guide to Periodical Literature* in your library

THE COVER THIS MONTH

This photograph of Chief Hind Bull was made at the annual Sun Dance near "Stand-Off," at a place called Belly Buttes, in Alberta, Canada. Chief Hind Bull is wearing a typical war bonnet of the Blood Tribe, made of eagle feathers and tipped with horsehair. This spectacular headdress originated in this area among the division of Indians known as the Plains Indians. Only since the coming of the white man has the feather bonnet become symbolic, in the popular mind, with Indians in general. Chief Hind Bull was dressed for his Medicine Pipe Dance, a part of the greater Sun Dance Ceremonial. It was said that he gave away 22 horses and many other gifts on this occasion. He is one of a number of so-called Minor Chiefs of the Blood Tribe, the Principal Chief being Chief Shot-Both-Sides.

In western Canada, Indian reservations are known as Reserves. The Blood Reserve of 356,000 acres is the largest in Canada. The Blackfoot Confederacy includes, besides the Blood, the South and North Piegans and the Northern Blackfoot tribes.

The photograph was taken by the late Dr. Clyde Fisher.

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THE TENETEHARA INDIANS OF BRAZIL

- - - - - - - by Charles Wagley
and Eduardo Galvão

Columbia University Press, $3.75
200 pp., 12 plates, 1 map

As exploration and colonization continue in Brazil's jungle-covered hinterland, it has been the fate of most primitive Indian societies to collapse before the impact of modern civilization. The Tenetehara Indians of northeastern Brazil, however, have been in contact with outside cultures for three centuries and yet have managed to adjust to changing conditions. Living an essentially aboriginal existence in the Amazonian rain forests, and without any understanding of commerce, they now operate within the world commercial system and are affected by market fluctuations in London and New York.

The Tenetehara's adjustment to a changing world is the subject of this fascinating and thoroughly readable book, the product of a happy collaboration between a North American and a Brazilian anthropologist. The presentation of Tenetehara culture is balanced and full, and the workings of the society are explained clearly in terms of vivid anecdotes.

Although the essential core of Tenetehara culture remains aboriginal, much has been modified through contact first with the Portuguese and later with rural Brazilians. The resulting changes in economics, social organization, religion, and folklore are traced with skill, and numerous comparisons are made to related, but less acculturated, Tupí-Guaraní speaking tribes.

The authors show how minor changes, once accepted, may set up a "chain reaction" throughout the fabric of a culture. Thus the Tenetehara first acquired a taste for manufactured goods. Subsequently their economy was modified from one of subsistence to one of production in order to obtain trade articles. Today native ceremonials are being abandoned because current economic conditions simply do not allow the Indians the time to perform them. Having swallowed the initial bait—and in view of increasing pressure from without—it is only a question of time, the authors believe, before the Tenetehara become rural Brazilians.

Harry Tschopik, Jr.

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- - - - - by E. Laurence Palmer

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Extensive as is this field book, Dr. Palmer had to leave out a section on historical geology, a section on galls, and some two hundred additional plants and animals which he had already prepared, just to make room for the sections on stars and rocks and minerals.

The author has included some of the more important domesticated plants and animals along with the wild ones because he believes "that people want to know more about cows, corn, cod and chickens."

Much of the material was rewritten from the Cornell Rural School leaflets, sponsored by the New York State College of Agriculture, and from inserts which appeared in *Nature Magazine.* The illustrations, most of which are excellent line drawings (the rocks and minerals and mollusks are photographs), number over two thousand and are the work of a corps of skilled artists, including the late Mary Eaton, Mrs. E. Burckmyer, and the late Louis Agassiz Fuertes. Scientific names as well as common names are used throughout, and the text is simple and nontechnical.

The purpose of this book, which was actually a decade in the making, is best given in the author's own words, ". . . the author has endeavored to write the kind of book he would have liked to have had available when he began the study of natural history as a youngster, as well as a book he can use now and in his old age to add the research and experience of others to what he may see for himself in his experiences with natural history."

JOHN R. SAUNDERS.

COUNCIL FIRES

- - - - - - - by Ellsworth Jaeger

Macmillan Company, $2.95, 253 pp.

HERE is an excellent title for the subject. It immediately brings to mind stars, trees, wind, night sounds, and the fragrance of cedar smoke. Is there a person anywhere who has not been thrilled to sit beneath a night sky, near a campfire, and listen to ancient stories?

Ellsworth Jaeger, Curator of Education at the Buffalo Museum of Science, has long been associated with camping and has written such books as *Tracks and Trailcraft, Wildwood Wisdom,* and *Easy Crafts.* He knew Ernest Thompson Seton, a master of ceremonies and without question one of the great storytellers of our time, and he includes in this book some of the lessons he learned.

In this volume there is a wealth of detailed information, copiously illustrated with pen-and-ink drawings. Step by step the author shows how to plan and stage a successful Council Fire. In detail, he explains the making of various types of Council Rings, then follows with the many articles to be used in the ceremony, musical instruments, clothing to be worn, then how to hold the council with dignity and impressiveness. A few Indian melodies are included and some colorful adapted Indian dances.

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"The Council Fire and the dance have been associated for uncounted years," and Mr. Jaeger devotes three chapters to this interesting subject. First, he explains some of the more simple dance steps used by the American Indian and then, in detail, outlines the dances that could be used.

Council Fires contains an amazing amount of information and appears at just the right time to remind every camp director that it should have a place on the library shelf this summer.

TE ATA.

THE ART OF FISH COOKERY

- - - - - - by Milo Miloradovich

Doubleday & Company, Inc., $3.50
457 pp.

MISS MILORADOVICH, who is an old hand at cookbooks, here gives us a book of world-wide scope and extremely detailed information. It covers fish and shellfish and also includes frog legs and whale meat.

There is a short description of the appearance, average size, general distribution, and abundance of each animal. Market forms, seasons, and producing areas are given in tables. Market cuts are illustrated. We are told how to clean and dress fish and how to shuck shellfish. Standard measurements both dry and liquid are listed. The cooking time is clearly stated in each recipe, as is also the state (very hot, cool, chilled, etc.) in which the dish should be served. There is a list of wines to be served with the various dishes.

There are recipes for smoked, salted, canned, and frozen, as well as fresh fish, and the author tells us what canned products may be substituted for fresh. There is, finally, a good index.

One thousand two hundred eighty recipes are contained in this smallish book, which nevertheless is printed in very legible, good-sized type. There are recipes for canapés, sandwiches, salads, broths, chowders, bisques, fumet, and bouillon; patties and puffs; sauces and stuffings; and every possible variety of broiled, boiled, baked, fried, and otherwise prepared fish and shellfish. The book is designed for use anywhere in the world and is not confined to our own fauna.

The jacket of *The Art of Fish Cookery* fails to state one important fact: Every recipe in this book has been actually tried. They have, moreover, been tried in ordinary kitchens. In telling how to make these dishes, the author does not assume the presence of a slave who can, as one old southern cookbook casually directs, "beat three hours," or of a staff of cooks and scullery maids. It does not even assume a technical knowledge of cooking terms. It is a well-organized, clearly and very appetizingly written book by an author who obviously knows all about fine food from the raw material to the final mouthful.

FRANCESCA LAMONTE.

THE WOLF AND THE RAVEN

- - - - - - - by Viola E. Garfield
and Linn A. Forrest

University of Washington Press, $3.00
151 pp., 67 photos

OF all artistic productions of North American Indians, totem poles, perhaps, have aroused the greatest public interest and curiosity. When and where these unique monuments originated, who made them, and what they mean, is the subject of the present book.

Totem pole carving was confined to the Tlingit and related Indian tribes of southeastern Alaska and western British Columbia. As popularly used, the term is made to embrace several classes of carvings that had quite different functions; some served as memorial columns or house posts, while others were grave markers or family crests. The carvings depict the heraldic devices of families and lineages or illustrate the mythological exploits of animals, birds, and supernatural creatures. Because of the complexity of this highly conventionalized art style and of the native mythology, the interpretation of totem poles requires an intimate knowledge of Northwest Coast symbolic art as well as familiarity with the legends. The bulk of the book consists of photographs of totem poles and of accounts and explanations of the myths.

Today Northwest Coast wood carving is almost a lost art, and many of these fine monuments lay rotting in deserted Indian villages. In order that some might be preserved, the United States Forest Service collected a number of totem poles from abandoned towns, restored them under the supervision of native artists, and erected them in several Alaskan parks. It was this project of restoration and study that led to the preparation of the present volume by an anthropologist and a Forest Service employee respectively.

Although a systematic summary of Northwest Coast culture would have contributed materially to a clearer understanding of both carvings and myths, this book should appeal to those interested in Indian art and folklore and serve as a useful guide to the totem pole parks of Alaska.

HARRY TSCHOPIK, JR.

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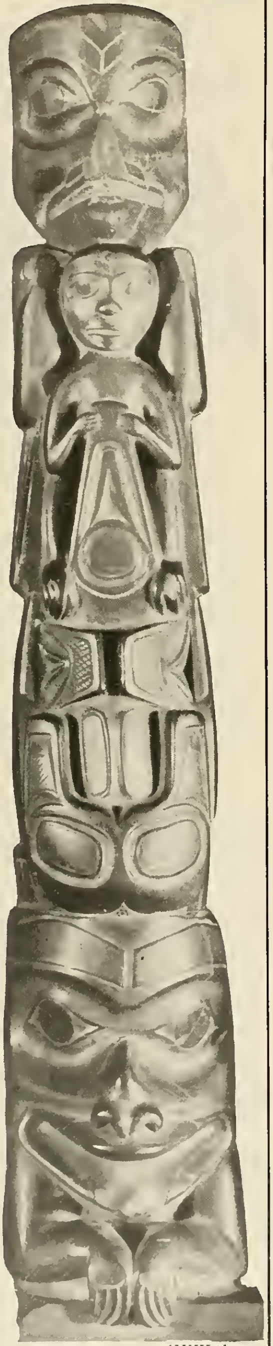


AMNH photo

▲ Haida totem pole carved in stone

WE had often seen argillite carvings in museums, and we took it for granted that they were of historic interest only. But when we came upon carvings in shops in Vancouver, we began to suspect that the ancient art was still alive. When we reached the Queen Charlotte Islands, off the coast of British Columbia, we discovered that the art was practically on its deathbed.

Louis Collison, sixty-year-old Haida Indian of Skidegate Mission, is the last of the old masters. He still works with a true eye and skilled hands, though he says sadly, "My father was better, and his father better still."

Louis himself carves the soft carbonaceous shale only in his spare time or when he feels like it. There's more money to be made with his fishing boat, going out after dogfish livers or trolling for cod or salmon. But when winter brings the furious storms that turn Hecate Strait into a maelstrom of angry waters, he unearths some of the stone from a storage pit in the back yard and sets to work. His is the best work being produced today, although another aging, half-blind native may turn out a greater quantity of inferior craftsmanship.

The Haidas of the Queen Charlotte Islands were long known for their artistic skills, being culturally one of the most advanced tribes north of Mexico. Their craftsmanship in metal, stone, and wood set them high among the North American tribes.

Apparently the carving began with dishes, amulets, pipes, and other small objects that were not strictly useful but were real works of art. Some were inlaid with iridescent abalone shell. Even then, travelers bought any they could find.

"These stone carvings are eagerly purchased by persons looking for Indian curiosities," wrote James G. Swan in a Smithsonian Report in 1874, "and are generally regarded by casual observers as idols, or objects of worship or indicative in some manner of their secret or mystic rites. This is however an

▼ Louis Collison, the last of th old masters, carving a totem pol with simple tools but in perfec symmetry. The design tells th legend of the Raven Stealing th Sun error. None of the tribes of the northwest coast worship idols or any visible symbol of their secret religion."

The Haidas found their "slate" carvings excellent items for barter with the mainland tribes, who in turn sold them down the coast to white traders. Wood and argillite carvings made to serve the native intertribal demand soon became important in the eyes of the natives.

Later the carvings became largely totem poles, miniatures from four inches up to twenty-four, though the latter are quite rare. These stone poles stylized the same designs that were used on the tall wooden totem poles. Argillite carving began around 1820, as far as can be discovered, and the totem poles did not reach their "golden age" until 1840-60. Wooden totems have not been carved on the Charlottes since 1880.

Louis Collison remembers all this. He is familiar with the work of the most outstanding of the argillite carvers, Edenshaw and Chapman of Masset, Queen Charlotte Islands. These two lived in the same village, but one was a chief, the other a freed slave. It was beneath Chief Edenshaw's dignity to notice the work or even the existence of the crippled slave. But they were rivals, nonetheless.

Fortunately for posterity, their work has been preserved in the Cunningham Collection in Prince Rupert. A shrewd trader, George Cunningham would show Edenshaw the latest of Chapman's carvings. The chief would snort—and bring in something better next time. But the honors remained even, for both were masters of their craft. Chapman, however, with his alien background, could draw upon the legends of his mainland tribe for inspiration.

An interesting feature about the Northwest tribes was that certain elements of their culture were regarded as personal or clan property. Songs, dances, stories, and totems could not be used by outsiders. That attitude persists today in a lesser degree. A craftsman now may sometimes obtain permission to use some other clan's motifs.

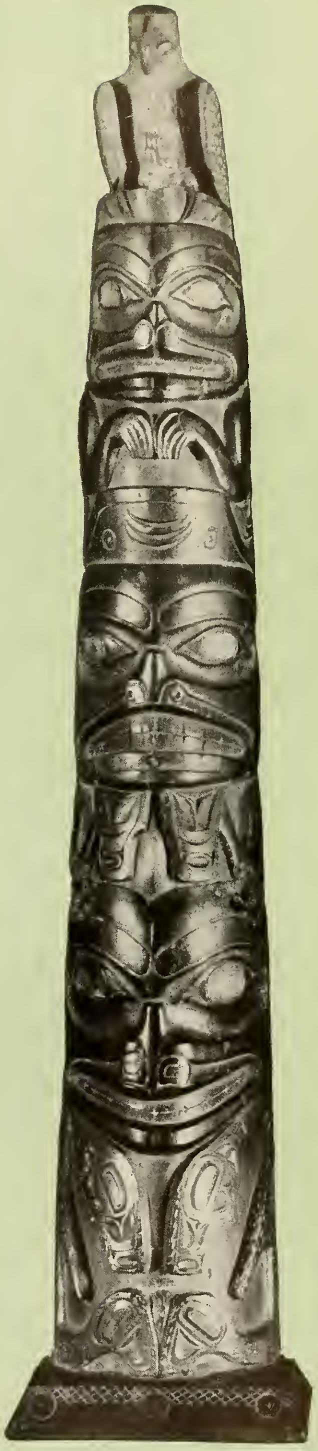
When we introduced ourselves, Louis Collison was in the process of carving the famous story of how Raven brought light to the dark earth he had created. In the complicated tale, Raven stole first the box of starlight, but that was not enough light. Then he managed to steal the moon, but the earth was still too dark. At long last, he contrived to snatch the box containing the sun and attempted to fly away with it. Unfortunately, he got caught

e Haida Carvers

The satiny-black stone carvings of the Northwest Indians win the esteem of all who see them, but they represent a dying art

By Lyn Harrington

Photographs by Richard Harrington
except where otherwise credited



AMNH photo

in the smoke hole of the lodge long enough to have his snow-white plumage permanently blackened. But he had light for his earth.

Louis Collison (his name was taken from one of the missionaries of a century ago) spoke infrequently and in soft, slurred English. He was distinctly shy in my presence, so on later visits I kept well in the background. He became friendly and at ease with my husband, eventually permitting him to take these photographs of the process. For so shy a man, this represented a great concession.

Only one deposit of the argillite is known along the coast. It is at the foot of Skidegate Inlet, halfway up the slope of the Slatechuck Mountains. Two years ago Louis made the long and arduous climb up the steep trail, now overgrown and cluttered with the debris of logging operations. Carrying pick and shovel and crowbar is no light chore for an elderly man, and on the return trip he had to carry the heavy rock, as well. But he had enough to last him for several years, at his present rate of production.

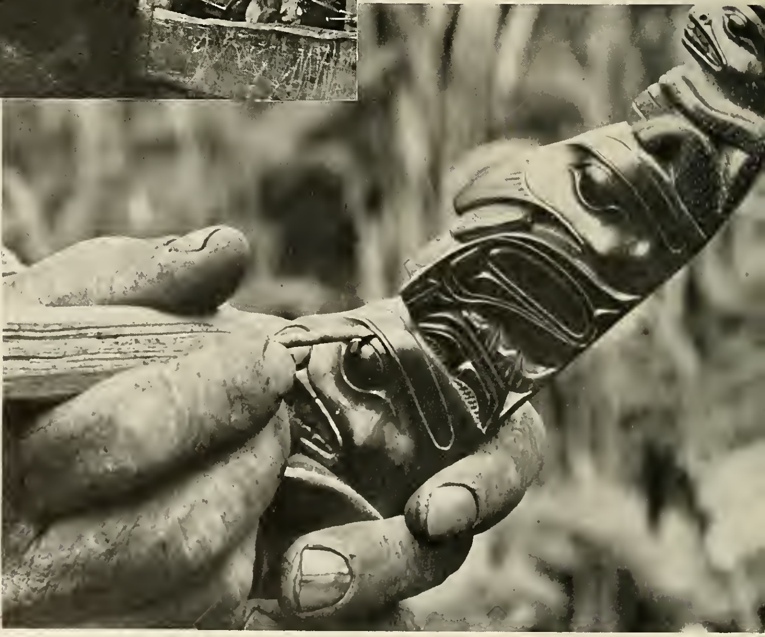
The argillite is really a carbonaceous shale. Sometimes it is called Haidite. Locally it is always called slate. It is relatively soft when first quarried, containing about eight per cent water, and is then easily carved. Upon exposure to air, the moisture evaporates and the rock becomes very brittle and easily split. To keep it in workable condition, Collison wraps it in moist cloths on the way home, then coats it with glue, and finally buries it in the earth.

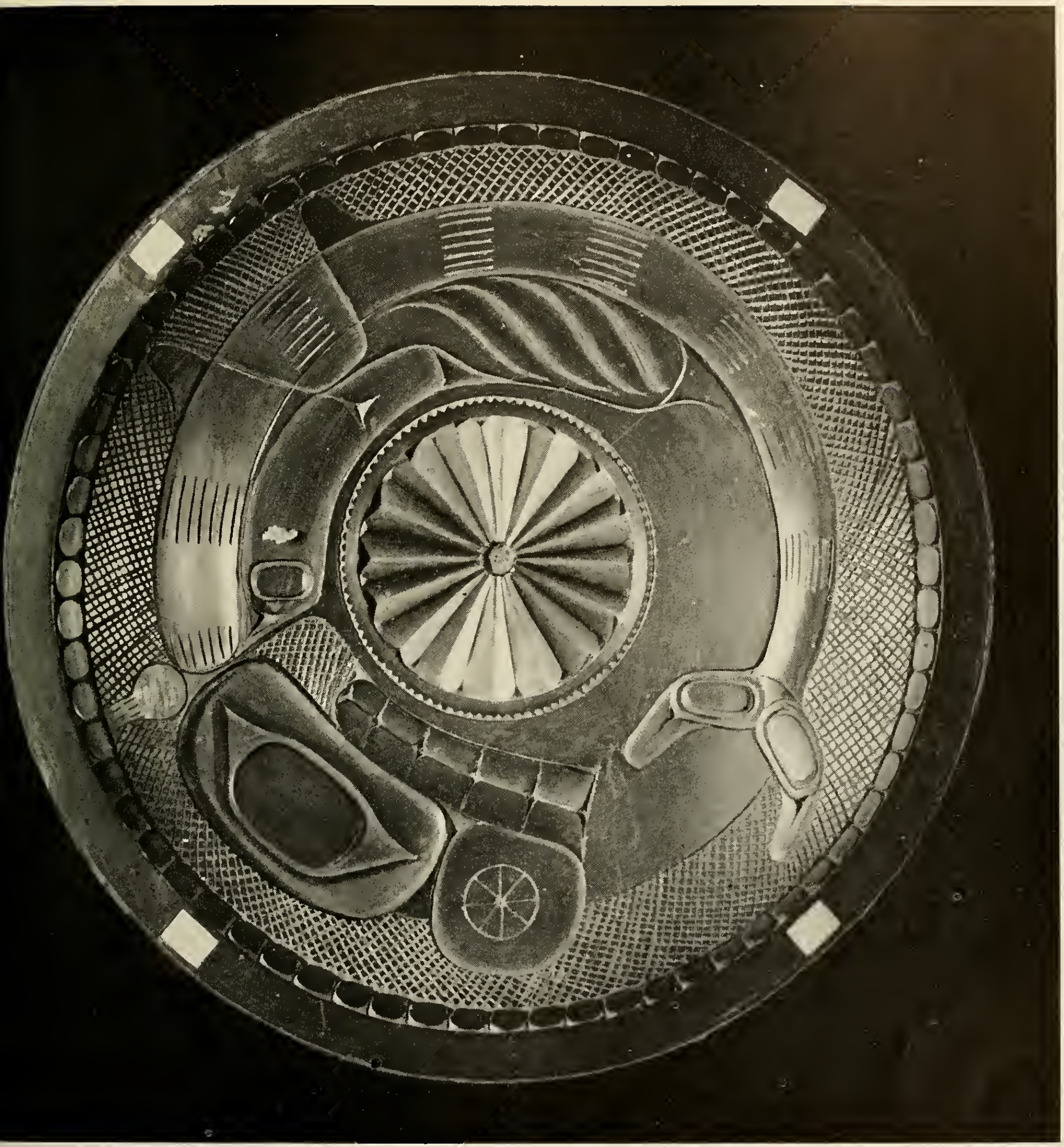
He does all his carving by hand. On occasion, white neighbors have pointed out that he could make much better time with a power tool. Louis just smiles and says, "Yah," in his gentle drawl. Power tools have been tried, it seems, but the slate chips too readily.

When the mood to carve comes upon him, he saws a piece off the block with an ordinary handsaw. This piece, too, he coats with glue to keep it workable. He tried woodworking tools but didn't like them. So he made his own, sometimes a flattened nail or an oft-sharpened paring knife. The argillite is quite

▲ LOUIS COLLISON sawing a block of the dull, dark shale to approximate size. It is kept coated with glue prior to use, to preserve its texture for carving

➤ FINISHING TOUCHES with a tiny chisel made from a flattened nail. Mr. Collison spurns the use of power tools and other special equipment





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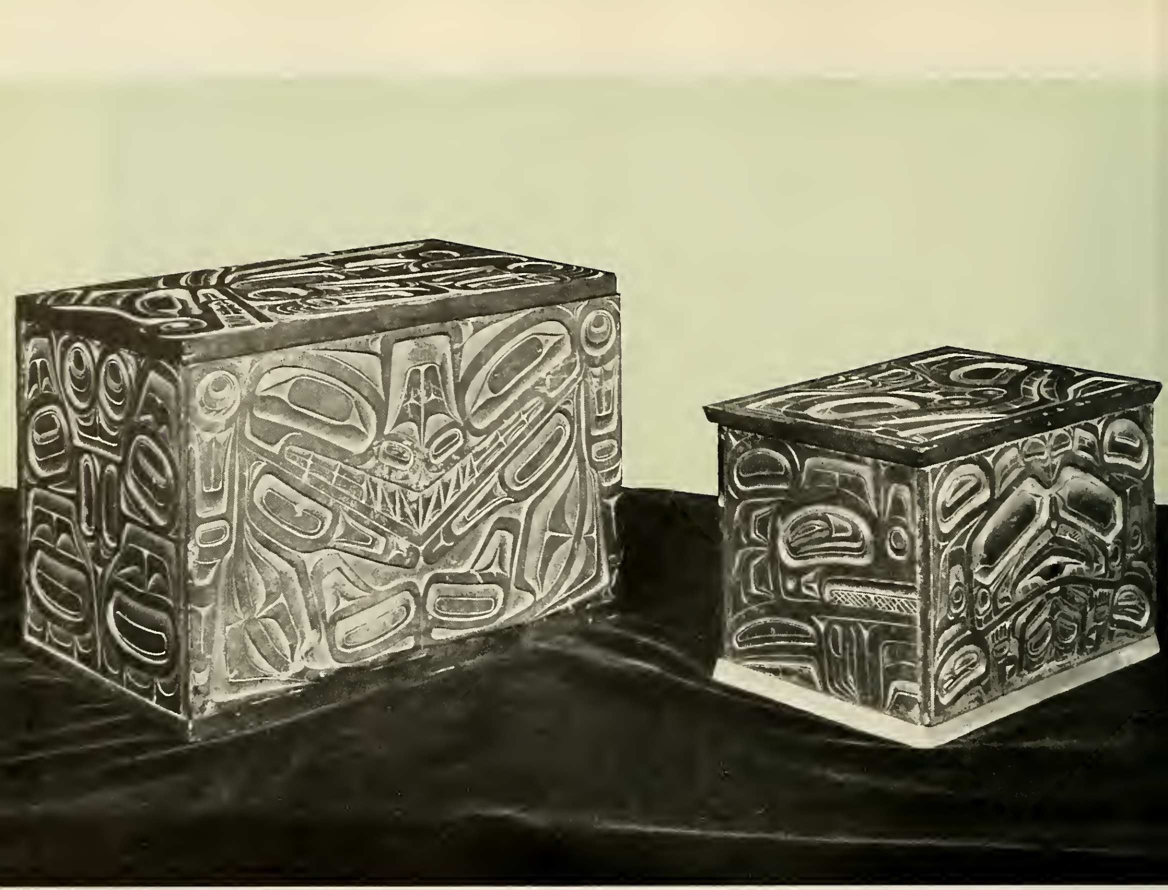
▲ A "SLATE" DISH carved by the Haida Indians off the coast of British Columbia, in the collections of the American Museum of Natural History

easily carved, being about as hard as plaster though of a different consistency.

His tools dull quickly, but he can sharpen them on the whetstone in his boathouse. He knows in advance just what he is going to carve and sets about it in a leisurely way, scraping and studying, turning the stone from side to side. He's never rushed.

Collison carves all his figures on three sides, leaving the back straight and smooth. His figures are exactly symmetrical, perfectly balanced, which is no small trick for anyone and quite remarkable for a fisherman untaught in the arts.

When he has finished carving, the material is still dull, dark gray in appearance, showing the tool marks. These he eliminates with sandpaper of various grades, until the entire surface is smooth and satiny. He digs into the confused litter of a drawer in his small



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▲ Carved boxes, showing characteristic ornamentation of the Northwest Coast Indians. American Museum Collection

worktable, brings out a scrap of cloth, and smears it with vaseline. He scrapes a bit of graphite off a soft, large logger's pencil and rubs the carving with it until it is black and shiny.

"They used to use shoe polish or stove polish on them," he said. "But that don't last long; rubs off." This finish is long-lasting and not only adds beauty but acts as a preservative.

The vaseline and graphite mixture is rubbed thoroughly into every little crevice of the carving and worked into the porous rock. Then Collison buffs up the carving until it gleams with a high gloss, a shiny jet-black piece of true Indian carving.

When my husband asked if he would carve a six-inch pole for him, he rubbed his stubble cheek with the back of his hand. He hemmed and hawed, didn't have time, was already two years behind with orders . . . Well, when did he want it? Two weeks? Louis wasn't sure, didn't think it likely. But the pole was finished when we returned, sure evidence that Louis had taken a fancy.

A six-inch pole might take two or three days to complete, and his rate of $1.50 an inch is certainly not unreasonable. It always makes for a better feeling all around if there's a slight overpayment! Considering the skill that goes into making the beauty of the true argillite carving, the price is certainly trifling.

This is only one reason why it is not popular with the young people. The main reason is that the Haidas are a proud people, long the lords of the West Coast. They do not want to maintain differences between themselves and the dominant white man. Native crafts that widen the gap between the two races haven't much appeal for these people.

"Fella over in Rupert wants lots of pieces," Louis told us with that slow wide smile, and shrugged, "I dunno . . ." Whether the fellow in Prince Rupert would ever get them was questionable.

The argillite carvings sold in Prince Rupert are perhaps the poorest examples ever placed on the market. Fantastically enough, it was one of these crude carvings that was chosen as a master-mold for turning out plaster reproductions en masse. These brought a price almost like that of the original slate carvings, from tourists on the steamships who didn't know the difference.

It is not the first libel on the

native craft. Before the war the Japanese mined and carved the argillite, easily copied the Indian style, and turned out fine workmanship. The leisurely native pace was no competition for the industrious Japanese. But in order to preserve both the craft and the source of the material for the natives, the Department of Indian Affairs of Canada bought the entire area and reserved it for them.

Louis Collison learned to carve by watching his elders and by application. That's the way to learn the art, he feels. When the Department asked him to teach the native children in the village school, he acquiesced, but his shrug indicated that it was uphill work. The youngsters took it as another lesson, something to be gotten over with as soon as possible

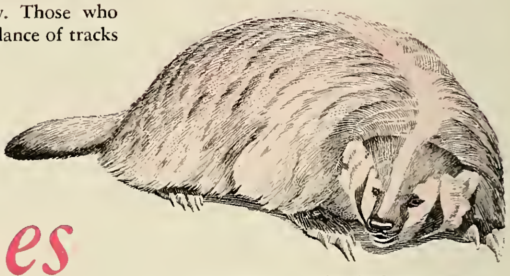
Possibly another artist will arise from among these pupils, or perhaps some of the young men who casually turn attention to the craft from time to time may yet produce some fine work. But to all appearances, Louis Collison is the last of the Indian masters in argillite carving.

▲ To GIVE the stone its glossy black sheen, shaved lead pencil is mixed with vaseline and rubbed over the finished carving

◀ A SHOEBRUSH finally brings up the luster to the artist's satisfaction. Pride in a distinctive art is giving way to a desire to emulate the white man. After Louis Collison, there will be no one to carry on this tradition

▲ **Where** a creature cannot move without writing its diary. Those who imagine the desert a lifeless waste will be astonished at the abundance of tracks

Tracks in Desert Dunes



▲ **Occasionally** the badger noses along the dunes at night, searching for fringe-footed lizards

Delicate patterns in the sand are the signatures of a host of desert creatures. Learn how to read the story of their unseen lives

By Raymond B. Cowles

Professor of Zoology, University of California

Photographs by the author except where otherwise credited

Our camp had been located close to the edge of a great expanse of desert sand dunes in southern California's Coachella Valley. Here, cradled beneath the towering, often snow-capped peaks of Mt. San Jacinto and San Gorgonio and the lesser desert ranges to the east, frequent winds of gale force sweep down over the sun-baked alluvial fans and dry washes to create and maintain the miles of sand dunes that were our special objective on this trip.

This was a class on their first zoological field trip to desert regions, and we were engaged in the study of the environmental conditions imposed upon plants and animals living in these areas. Until midnight the class had been subjected to a cold wind that howled around our sleeping bags, rattling gravel and sand against the canvas covers we had turned up over our heads for protection. However, by sunrise not a breath of air was stirring to suggest the previous night's turmoil. This was most fortunate, for the evening storm and morning calm meant ideal conditions for the special type of work we were hoping to carry out.

Plants and animals with many interesting adaptations make their homes in this wind-transported soil. Some of them show a preference for the outermost deposits, which are as fine as dust. Here many plants grow thickly, and the associated animals find ample cover. Other plants and animals live right up to the borders of the dunes, where the sand is as fine as that in an hourglass, while others, fewer in number, occupy the dunes themselves. These latter are the most specialized of all the sand-dwelling organisms.

The forces responsible for these sand dunes are, of course, the strong winds that are so frequent in desert territories; but paradoxically, the dunes are at their best only where the gales begin to weaken in force and therefore deposit their loads. Also, the dunes must have a source from which the sand can be brought. In desert areas, which are often remote from any point of contact with either ancient or modern sea beaches, the only sand available is carried by the rare but usually violent rains and ensuing flash floods, which strip the adjacent mountains of an accumulated store of sand grains and gravel. These sudden torrents of water and debris smash downward, grinding boulders into pebbles, pebbles into sand, and finally sand into mud. Eventually the muddy, turbulent flood pours out over the alluvial fans and even to the desert's edge. On these slopes and on the deserts the water vanishes underground, leaving behind it a new cover of loose soil.

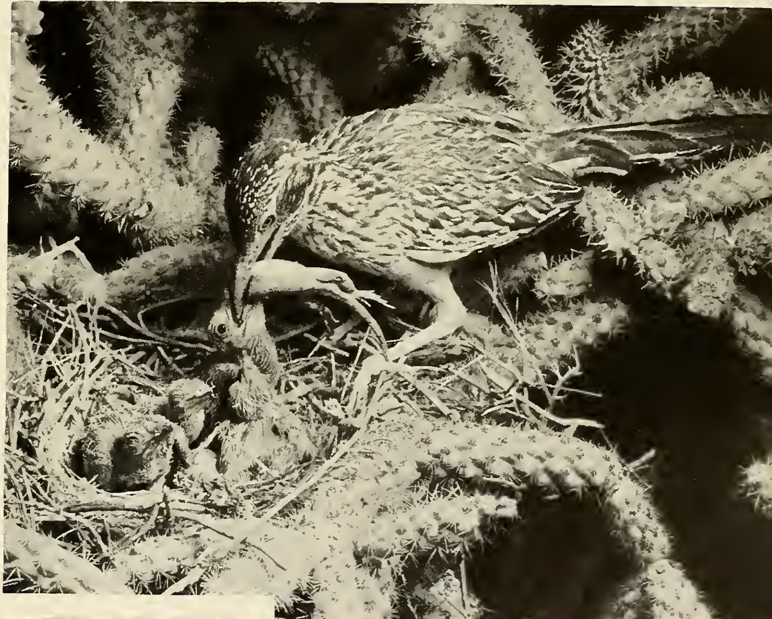
At this point the winds pick up where the water left off and whirl a new burden of sand to ever greater distances, winnowing the fine from the coarse until at last the air-borne load is deposited to form great stretches of uniformly colored sand, a mixture of the various-colored minerals of which the mountains were composed, sorted as to size and coarseness by the diminishing velocity of the wind.

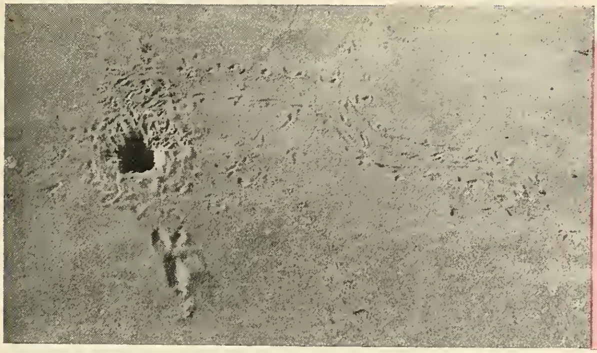
One of the most important reasons for selecting this area for our work was the inestimable advantage of easy tracking. In the dunes themselves, as well as along the margins of fine sand and dust, almost all of the animals, both large and small, emerge at one time or another to write the story of their natural, unaltered activities. We had come to the desert in order to read these stories.

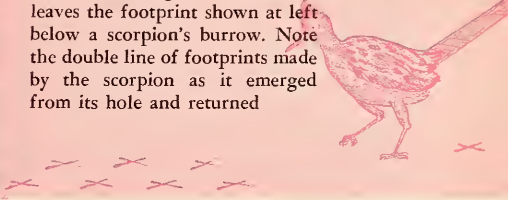
By their shyness and frequently by their nocturnal habits, most animals manage to conceal some of their more fascinating activities. Most life histories of small animals must be learned the hard way; that is, by long hours of patient watching in the field, in the hope of gleaning an occasional fact bearing on their lives by the chance detection of a few of those almost instantaneous episodes that take place. Observations on captive animals in the laboratory or zoo are extremely helpful, since they provide many valuable hints of what to look for. Nevertheless, such observations can be misleading and should be checked against the behavior of each animal as it lives in nature.

The shyness of animals does not mean that they consciously conceal the secrets of their lives from us but that in order to survive at all they must vanish from sight at the faintest suggestion of a strange sound or movement. Therefore, only rarely do our thudding feet and imperfect vision allow a glimpse of their most intimate activities or of the often deadly serious episodes in their daily life. At best, their most dramatic moments are past and over within seconds or in a few quick heartbeats. In order that it too may live, a predator strikes down its prey, and panic, struggle, and suffering are over so suddenly that the would-be spectator very rarely sees any part of the action. The same situation is

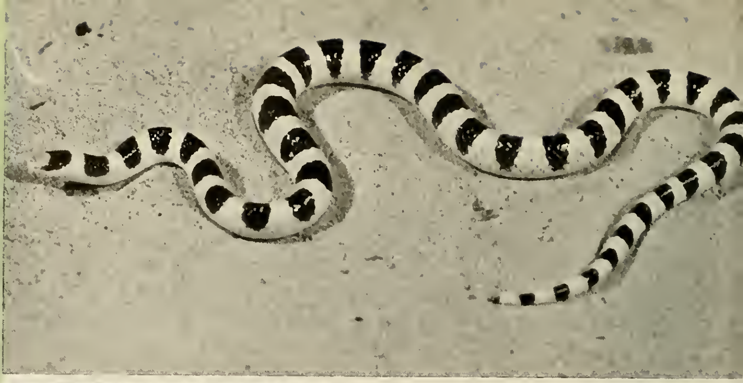
Eliot F. Porter, from National Audubon Society



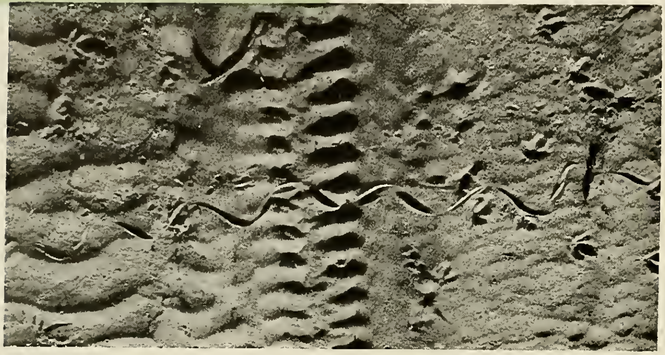




THE ROAD RUNNER can hold its own against a rattlesnake, but more often it patrols the sandy ridges searching for lizards. It leaves the footprint shown at left below a scorpion's burrow. Note the double line of footprints made by the scorpion as it emerged from its hole and returned



➤ THE HARMLESS SPADE-NOSED SNAKE, only a foot or so long, leaves a perfect serpentine curve in the sand. It is almost impossible to catch one on the sand, but at night they cross the highways



➤ CAN YOU TELL which way spade-nose was going? Other tracks here are those of desert quail, scorpion, and an unidentified mouse

AMNH photo

usually true of play, mating, and often much of the courtship behavior. Further, during the daytime when our eyes are able to see well, a vast host of nocturnal animals are either sleeping underground or carrying on normal activity in darkness and invisibility. Animals that are subterranean may also come to the surface chiefly at night, when we can see only faintly at best. It is for these reasons that sand tracking can prove to be a valuable aid to an understanding of an animal's life and can reveal much that is new, unknown, or possibly just guessed at.

To most people the sandy wastes of the desert seem to be devoid of life and interest. To the biologist or naturalist, however, it is soon apparent that the sand hills swarm with life of the most interesting kinds, much of it specialized for the peculiar needs of its existence. Most of the sand dwellers live either just beneath the surface or even deep underground, in either case in complete or almost complete darkness. But you may be surprised to find how vividly they leave their record during their almost universal night wandering.

Although records in sand are notoriously impermanent, the fact remains that they usually persist for hours or sometimes even days. Thus they provide a record that endures a thousand times as long as the dramatic event that took seconds for its completion.

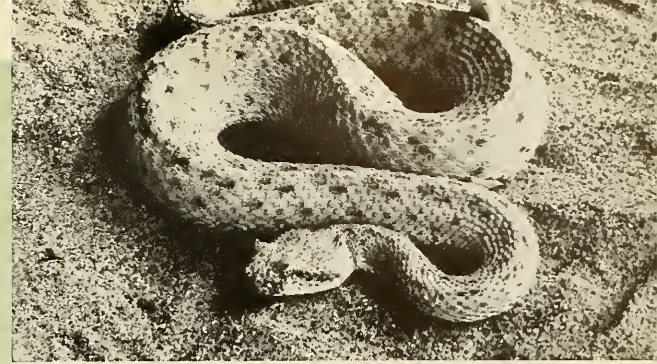
The study of tracks and the reading of evidence on the way of life of desert animals is chiefly an art. Nevertheless, the use to which the information is put is a phase of descriptive science and requires some scientific training to be of the greatest value. Wholly new information on some details of the lives of birds, mammals, snakes, and lizards, as well as many kinds of arthropods, is easily available to the naturalist. The chief requirements for pursuit of this interesting activity are patience and average eyesight. Sometimes a modicum of fortitude in the face of high temperatures is needed, but the tracker is most active only during the most beautiful hours of the day—early morning and late afternoon. At either of these times the desert heat has moderated, and the nearly horizontal sunlight reveals the full array of flamboyant desert colors, reflected from the sand and sometimes from rare clouds. Always the higher elevations of the mountains receive the first and last rays of the rising and setting sun.

The naturalist chooses these hours near dawn and dusk not because the heat of the day is diminished but for the simple reason that the tracks show most clearly under such conditions. The harsh midday sun, with its vertical rays of glaring light, subdues the shadows and almost obliterates from vision the slight impressions made by the feet, tail, and, in some instances, the bellies of desert animals. When the light rays strike the ground obliquely, every inequality or disturbance of the dusty surface stands out so clearly that a photograph sometimes looks like a picture of some curious bas-relief.

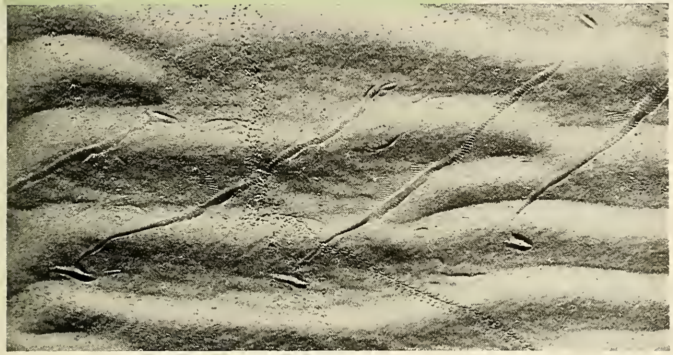
Trackers try to walk toward the sun, or at least they work with the light shining toward them, for then the previous passage of an animal, even one as small as an insect, is marked by dark shadows against a high-lighted and universally brilliant background.

Beetles reveal their locomotory peculiarities by their curious outward-toeing prints. These sometimes suggest the footprints of a bird, because the three legs on each side of an insect leave imprints resembling those made by the three-toed foot of most birds. The most conspicuous difference is that birds do not toe outward so sharply or take such short steps.

Tracks of tarantulas and scorpions would be difficult to distin-



➤ The sidewinder leaves ladder-rung tracks that mystified scientists for a time. They are unlike any others you will see. Instead of wriggling, the sidewinder flows smoothly sideways like a flattened, rolling coil. Note marks left by the belly scales



▲ Late riser: a sidewinder basking in a depression it made for itself. The rising sun will soon force it to seek shade under a shrub or in a rodent burrow

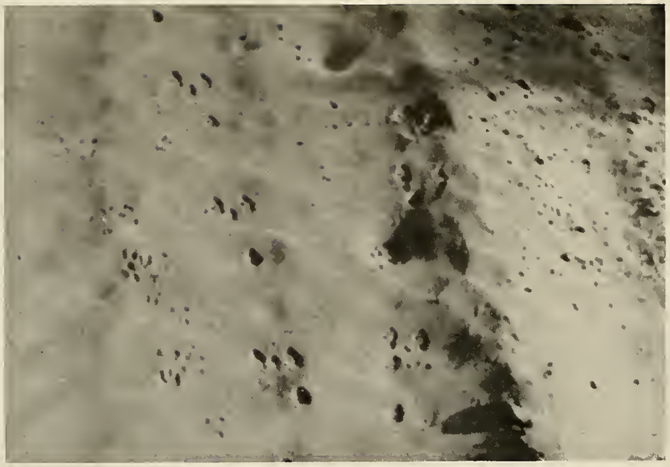
guish from each other except for the fortunate fact that sooner or later scorpions drag their "tails," leaving an identifying middle track. When scorpions trails are first seen, and when the track ends in an obvious burrow, the novice is tempted to dig down to capture the occupant of the hole and discover who made these intriguing marks. By such rash tactics the identity of the occupant is often revealed with painful suddenness by a red-hot burn on the end of a finger. Fortunately, west of Arizona this burning sensation is the only symptom apt to follow such a sting.

You can tell a jack rabbit from a cottontail because the jack rabbit walks or runs, whereas the cottontail hops, simultaneously moving the hind feet while the front feet are taking single steps. The cottontail thus produces a curious cloverleaf pattern, which you will easily come to recognize wherever the animal has passed by. When frightened, it hops or leaps, bunching its feet to form another type of track.

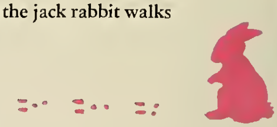
Almost all individual trails are crisscrossed here and there by the tracks of two common desert lizards. The tracks of the whiptail, *Cnemidophorus,* which are thin and rather sharply cut, are made up of toe markings separated by the groove of the lizard's trailing tail. Those of the desert iguana, *Dipsosaurus,* normally resemble those of the whiptail except for their larger size and thicker tail mark. When this lizard emerges from a cold burrow and has the temerity to walk across the open desert, the dragging toe-marks indicate the awkwardness and inefficiency of a reptile's locomotion when the temperature is low.

Sooner or later you will encounter the broad, "squatty" tracks of the flat-tailed horned lizard. In fact, the tracks will be much easier to find than the animal, for this rarest of California "horny toads" has the habit of remaining completely motionless in the presence of danger. This habit is fully justified by the perfection of the lizard's concealment under or beside any little wisp of cover or even in the speckled shadows cast by creosote bushes. This "horned toad" is one of two or three species of lizards that feeds voraciously on the fiery-stinged agricultural ants. It is notable that both prey and predator seem to exercise a considerable degree of mutual respect. When the lizard is lying near the burrows of the ants, they remain below the surface, appearing only from time to time, with their actively moving antennae just protruding at the entrance of their nest. Since the lizard has been observed eating as many as 60 of these rather large ants at one sitting, the wariness of the ants is not surprising. On the other hand, if the lizard happens to be lying near the nest when it is broken open, the excited occupants swarm out onto its body, and it beats a hasty retreat. This seems to indicate that the lizard escapes being painfully stung only when it is the aggressor.

One of the more interesting lizards, the velvet-skinned fringe-footed lizard, or *Uma,* is caught by



◄ COTTONTAIL RABBITS move both hind feet at once to form tracks like these, whereas the jack rabbit walks or runs



a variety of techniques, the choice of which depends mainly on the time of year or time of day. In April, May, or early June, one of the more successful methods is to walk along the steep leeward faces of the larger sand hills. Here the soil lies at a sharp angle of rest, and any slight disturbance on or just below the surface sends a rivulet of sand flowing down the steep slope. The resulting scars on an otherwise unmarred surface usually represent a night resting place and an early morning stirring of the lizard. If you grasp a handful of sand at the apex of the slide area, you will often find yourself in possession of one of these exquisite reptiles. But a word of caution is needed, for the venomous little sidewinder rattlesnake is also in the habit of concealing itself underneath the sand. So far, we have found no sidewinders hidden in these leeward faces of the dunes, and probably none will be found on such a steep slope; nevertheless, caution is suggested.

The fringe-footed lizard is among the more dune-adapted of our lizards. Its flattened body and smooth surface texture seem to permit expert diving into and under the sand. The feet are fringed with rows of valvular scales, arranged so as to facilitate pushing movements or "swimming" beneath the sand. The problem of sand or dust getting into their eyes, nostrils, and ears is adequately solved by intricate eyelids, valvular nostrils, and by moisture in the nasal passages which helps to collect and discharge extraneous particles. Also, there is provision for ample moisture around the eyes. Finally there are ejecting mechanisms, which eliminate any dust that may have passed the previous defenses.

This fascinating lizard is so beautifully matched to its background of open sand, or for concealment under creosote bushes, that one has difficulty discovering it. Even when seen, its agility and its sudden dives under the sand make it extremely elusive. However, a close examination of these reptiles is worth the effort of capturing one, for in the hand they are astonishingly attractive, especially in the springtime when the postnuptial color shows as an almost orange-vermilion wash on an otherwise snow-white undersurface. On the back, the spotted or ocellated pattern, which originally gave the animal its name of ocellated sand lizard, is made up of tiny dark maroon or almost black spots.

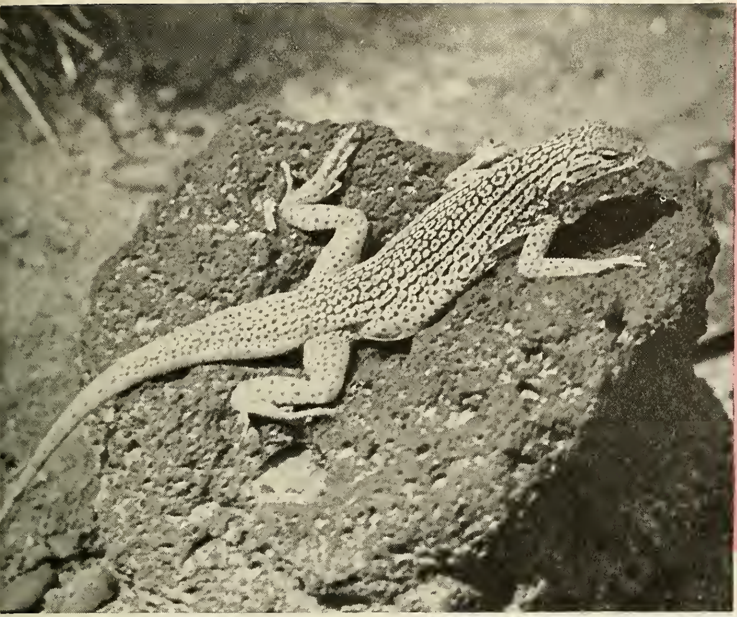
Close examination of the head reveals an organ so like an eye that it is often referred to as the third or pineal eye. This structure is located on top of the head, behind the true eyes. It so closely resembles a real eye, with pupil, iris, and curved lenselike covering, that you might suppose it must have some real function. But if there is a use for the "eye," it has not been demonstrated, although there does seem to be a possibility that it may function in regulating the temperature of the brain. This is now only a hunch with no direct evidence to support it. Several other species of lizards with somewhat similar habits have nearly as conspicuous pineal structures. In any event, whether the "eye" is useful or not, the fringe-footed lizards are among the most numerous occupants of the sand dunes, and their abundance indicates a high degree of success.

Along the ridges where the views are best and where the sun's first rays warm up the sand, these lizards find a situation that seems especially attractive to them, at least during the early morning and late afternoon. However, it is along these same ridges that one finds the "Maltese cross" tracks of one of their most active enemies—the lizard-eating ground cuckoo or road runner. These active birds forage along the crests of the ridges, and you may be able to follow their tracks for many hundreds of yards. These excursions are probably productive as a rule, for they seem to represent a regular habit, and the most abundant supply of potential food consists of these beautiful little lizards.

Although no longer common, the badger also makes excursions in these dunes; but its activities are chiefly confined to the night hours when, according to information gleaned from their tracks, they "nose" along, sniffing at likely places and occasionally finding a sleeping fringe-foot.

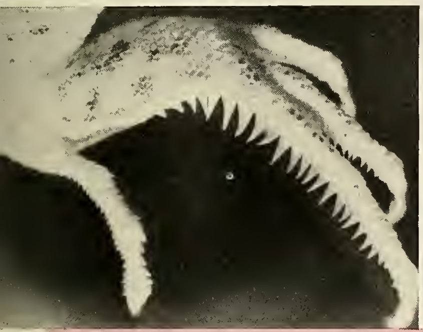
Collecting and tracking daytime animals is especially difficult in the evening because of the confusion that results from the day's accumu-

C. M. Bogert photo

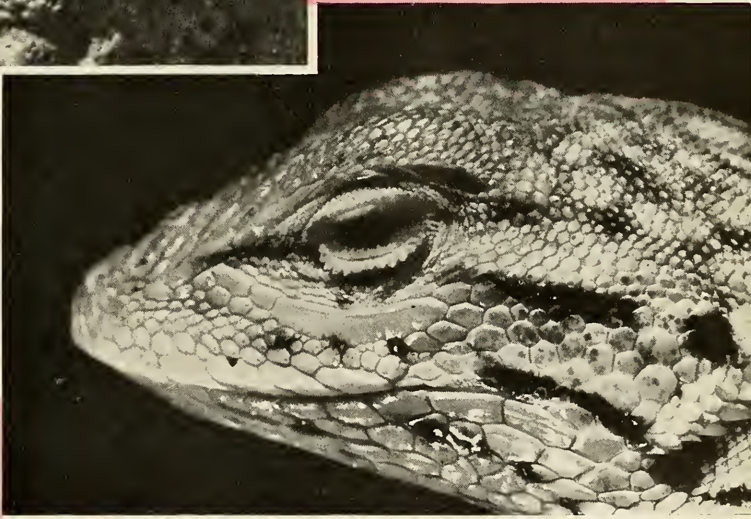


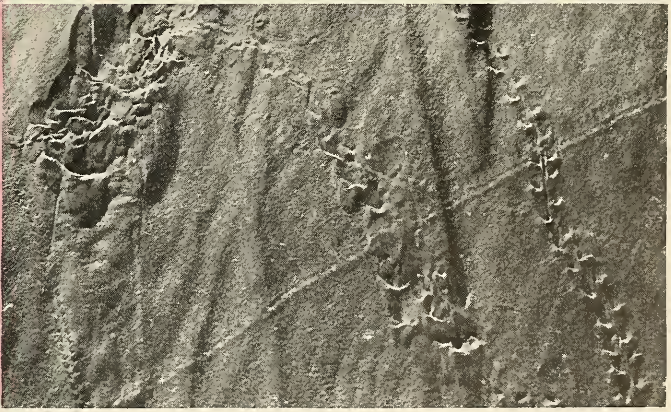
◄ THE FRINGE-FOOTED LIZARD, with flattened body and beautiful, smooth skin, is well equipped for diving into and under the sand

▼ PROTECTIVE SCALES above and below the eye and a double, dustproof fringe on the eyelids help protect the wedge-shaped head of fringe-foot



▲ ITS FRINGED FEET enable it to "swim" under the sand, thus baffling the hungry pursuer and the student of tracks





► AT UPPER LEFT, a fringe-footed lizard enjoyed an early morning sun bath, then proceeded in a leisurely fashion to lower right. It then moved back toward upper right. The diagonal tracks are those of a beetle lation of tracks. The scurrying activities of round-tailed ground squirrels, lizards, and a host of insects clutter the surface and make it almost impossible to follow any one trail to its conclusion. Sometimes a similar situation is encountered in the morning. Fortunately, the very conditions that create the dunes also supply a remedy in the form of frequent windy nights that erase all previous tracks and leave a smooth "slate."

By taking temperatures at critical times, much can be learned concerning the maximum and minimum temperatures acceptable to nocturnal animals and the approximate time of their activities. Eventually, it should be possible to accumulate valuable information on the extent of their nightly movements, both during and after the mating season, and also the degree of population mixture and other facts of general biological importance.

Observations are especially significant whenever the usual evening winds have been brief. One of the more interesting animals of which you may find evidence is the little spade-nosed snake, *Chionactis*. This small serpent makes almost perfectly symmetrical trails of sinuous lines, a smoothly flowing succession of continuous "S" tracks that start from under one bush or hummock and pass to another.

As in all snake tracks, the piling of a faint accumulation of sand *behind* the loops indicates that the snake was moving away from those portions of the curve. In spite of this easy guide to where it went, it is almost impossible to catch these snakes in the daytime. Only twice in hundreds of trips have we observed them on the surface during daylight hours, although at night, while driving along dark asphalt highways on the deserts, they are not uncommonly collected. These harmless little snakes, a foot or so in length, include in their diet insects and other arthropods, even to fairly large and powerful scorpions. In the laboratory they feed on centipedes, and even these seem of formidable size for them.

Among other interesting tracks are the slanting "ladder-rung" trails of the sidewinder rattlesnakes. These are totally unlike the tracks of any other native snake, and for years the mystery of exactly how they were made baffled naturalists and laymen alike. Many hours of careful observation of the moving snake, and of the tracks it leaves behind, failed to elucidate completely the problems of its locomotion.

One scientist, a man more ingenious and with deeper insight than his predecessors, visualized the movements as those of a flattened, rolling helix, a one-and-a-half spiral. The little rattlers flow smoothly sideways, hence their colloquial name. That there is a rolling motion is shown clearly in the imprint of the belly scales, which form transverse, treadlike lines. No sliding movement could leave such imprints, any more than a skidding tire could leave its tread marks.

Slow-motion pictures show in detail the sidewinding locomotion. But a simpler way is merely to put the snake into a refrigerator until it is chilled into slow motion. For purposes of study, this is as effective as the slow motion brought about by the use of moving pictures and trick photography. For those who have access to the snakes and are possessed of a desire to study this method of progression, a chilled sidewinder serves the purpose admirably.

In its native habitat, of course, the sidewinder does not venture abroad when air temperatures are much below 65 degrees F. Chilled sidewinders are rarely encountered in nature and for very good reasons. Like all other reptiles, cold reduces them to helpless torpor, and they become easy victims for any active carnivore.

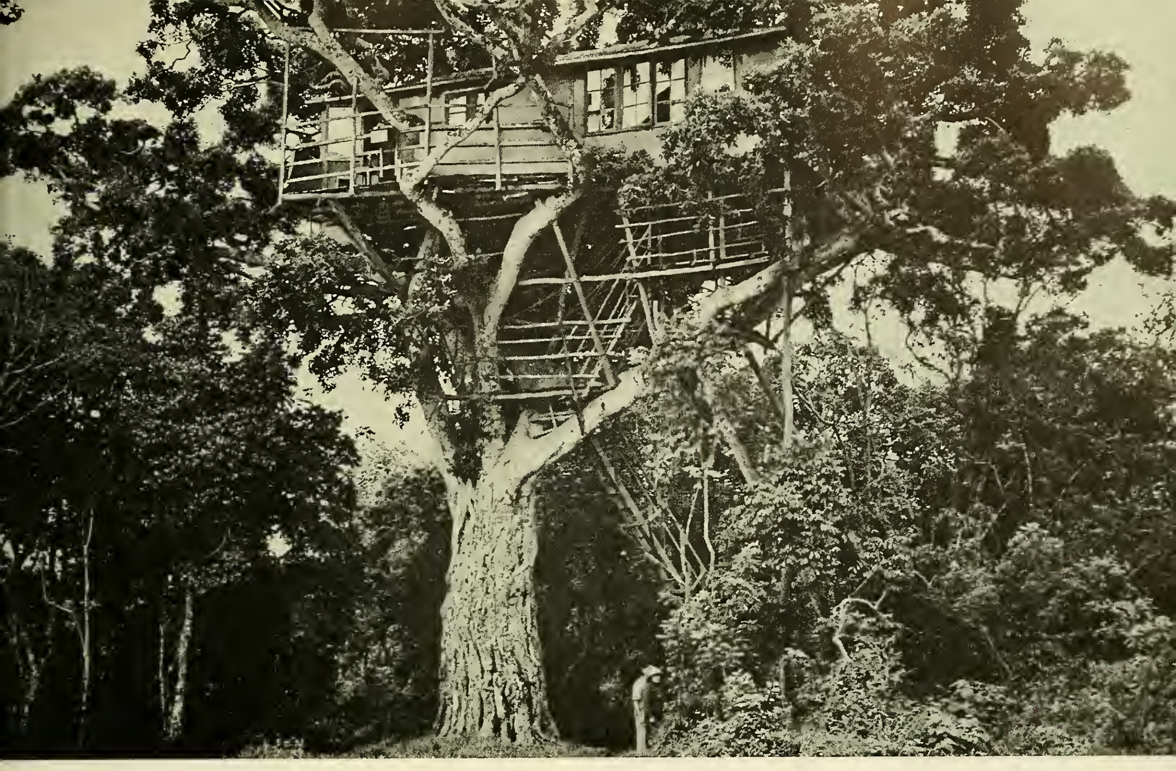
Thus the cold wind that howled around our sleeping bags was a source of comfort to the timid members of the class. It meant that no sidewinders were abroad so late that night. Yet the following morning when the wind had subsided and the morning sun began to heat the substratum, many of the animals buried under its protective covering resumed normal activity.

Meanwhile, at the crack of dawn, the class was at work reading the evanescent record of night life on the desert. Here was the depression left by a sidewinder when he paused as the temperature dropped. Sand carried by the cold night winds had drifted over the snake, but he had vacated the spot when the morning sun raised his body temperature to the point where he could seek the shelter required to avoid the midday heat. Some fringe-footed lizards were already abroad, but the more observing members of the class spotted some telltale scars on shaded parts of the dunes and readily captured the still torpid saurians.

Round-tailed ground squirrels and the whiptail lizard soon began to swarm over the sandy surface, obscuring the record. And yet if time were taken, each member of the class could read the record and draw reliable inferences before the pattern was cluttered or erased by the winds of the following evening.

Sandstorms may occur at any time, but they become less frequent toward the end of spring. Late April, May, and October, with their cold nights and often hot days, are probably the ideal months in which to visit the desert. These months, and also June, are certainly among the best, if the student of reptile life hopes to see all that the region offers—and the desert at its prime is unsurpassed.

For observations on birds and mammals, unless special studies are contemplated, the winter months are most comfortable; but those who plan to camp should recall the words of the familiar song and remember that the sands of the desert do grow cold and that snow and ice are not unknown—even in the famous town of Palm Springs. Tracks in the snow are interesting, too, but they are likely to be confined to animals provided with internal heat—the birds and mammals. Most reptiles, including the snakes, will already have retired for their months-long winter rest.



▲ **Overlooking** a pool frequented by a wide variety of African animals, Treetops offers the naturalist or wildlife photographer a unique opportunity. It is located almost on the equator in the interior of Africa, but electric lights, running water, and full-course meals make this one of the world's most remarkable hotels

"TREETOPS"

From a unique inn tucked high in the branches of a wild fig tree, a panorama of African wildlife can be observed while you enjoy the comforts of home

By Lt. Col. *and* Mrs. William J. Morden

Leaders of the Morden African Expedition of the American Museum of Natural History

Photographs by the Morden African Expedition

THE past few years have changed the character of much of Africa, and the little town of Nyeri, which lies in the upper reaches of the Tana River valley between the towering, snow-clad peaks of Mt. Kenya and the magnificent forests of the Aberdare Range, clearly illustrates this. Not many years ago great herds of game roamed where Nyeri now stands. Today, in the center of a prosperous agricultural region, it is a holiday resort, proud of its excellent hotels, golf course, tennis courts, pleasant homes, and beautiful gardens. And yet, despite these new developments the surrounding country has changed less than one might imagine. A friend who drove in to see us from his farm only a few miles distant did not feel free to remain for dinner. In driving home after dark, he explained, there was too much likelihood of meeting elephants or rhinos on the road, for among the forests on the near-by mountain slopes the animals still range almost as freely as they ever did.

Our reason for visiting Nyeri was not only to enjoy the comforts of the delightful Outspan Hotel or the attractions of the town. We were on our way to a simpler but much more remarkable inn that lies a few miles away in the forest—a unique hostelry containing only four rooms, which is built high among the branches of a huge wild fig tree beside a forest pool. It is appropriately called "Treetops." In reality, this strange inn is a kind of glorified observation post from which to watch the animals that come nightly—especially during the full moon—to drink and wallow in

ELEPHANT
IN FOREST
GO SLOW
AT NIGHT

➤ **En route** to Treetops, signs remind the traveler that he is not among tame animals

the pool. It is a surprise to have electric lights, running water, and excellent food while observing the nightly movements of a wide variety of wild animals.

The idea was conceived by Eric Sherbrooke Walker and his wife when numerous visitors to this part of Africa wanted to see more big game than was easy to guarantee on the usual trips into the forest. Also it was rather risky on the ground. Several times a party unexpectedly encountered a rhino too close for comfort. Mr. Walker had, in his youth, been a lover of Barry's play *Peter Pan*, and he and his wife conceived the idea of a hotel in a tree. After many expeditions into the forest, he at last found the ideal place—an enormous tree on the downwind side of an open glade frequented by all the animals, with a pool in the middle. To make the pool more to the animals' liking, he added salt.

Treetops is open to visitors only during the full moon, and we had to make reservations several weeks in advance. Shortly after noon, we entered the station wagon to drive the six or seven miles from Nyeri toward Treetops. In addition to the driver and several porters with boxes of food and supplies, there was the Assistant Manager of the Outspan Hotel, who was to act as general factotum, and a so-called "white hunter" carrying a heavy double rifle. It was his duty to escort us in safety to our quarters in the tree. Having traveled among big game in various parts of Africa during the preceding months, we were unimpressed with the importance of this precaution. We had been advised not to bring our own heavy rifles, because there is no shooting here except for self-protection, as in some other sections of Kenya Colony and elsewhere in Africa. In fact, there is a definite trend today toward big game photography instead of big game shooting.

We soon learned that no road led directly to our destination. The last half mile or so of the way was nothing more than a winding path through thick forest and dense bush, along which we had to make our way on foot. Also, we gained a new understanding of that last half mile when we saw that almost every reasonably sturdy tree along the trail had crossbars nailed, ladder fashion, to its trunk, up which one could make a quick getaway if elephants, rhinos, or buffaloes made that seem like a good idea.

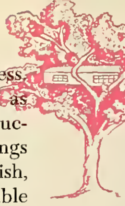
We didn't linger on that trail, and after an uphill climb we reached a little glade and caught our first glimpse of Treetops. Directly beside a glassy pool a few hundred feet in diameter stood the huge fig tree, its massive trunk 5 or 6 feet thick, with several great branches standing boldly out at a height of 30 or 40 feet. Among these branches was Treetops.

As inns go, it was, of course, small. Yet high in that immense tree, it did not seem so. We spent little time observing it from the ground, for the forest pressed in close on every side and animals, we were told, would soon be coming to the pool. Naturally, we wanted to be topside to see and photograph whatever came while daylight lasted.

By way of a narrow ladder we began our climb into the tree; but shortly the ladder led to a flight of steps which, winding back and forth, took us ultimately to this treetop bungalow. The Assistant Manager and two "boys" accompanied us, and some supplies were sent up. The white hunter then turned back with the other porters to return to Nyeri. Even before they had disappeared along the trail, the ladder that formed the lower section of our way into the tree was hauled up among the branches and made fast, leaving us safely cut off from the ground. The trunk of the tree itself was heavily wrapped with barbed wire to keep leopards and other climbing predators away.

The house in which we found ourselves was what every child has dreamed of—a fairy tale place come to life. It was ideally designed for its purpose and, to our surprise,

➤ **At intervals** along the trail to Treetops, ladder rungs are nailed to the trees to provide ready escape in case of attack



➤ MANY famous personages have climbed this ladder to sign the register in Treetops. The ladder is pulled up at night for safety against prowling animals. The trunk of the tree is wrapped in barbed wire

remarkably sturdy and motionless. There was no quiver, no shake, as one might expect in such a structure. And though its furnishings were rustic and far from lavish, everything was most comfortable and complete.

A living room that may have measured about twelve by fifteen feet was carpeted with rugs and contained a long table, together with benches, chairs, and a desk upon which lay a huge guest book. Here, previous visitors had described their experiences in great detail, sometimes even with sketches and verse. There was a full-sized double bedroom and a smaller one with a cot in addition to a bed. The kitchenette contained a stove which was later to become welcome, not only for the meals it made possible but also because as night fell the air turned sharply chill. Two toilets and a separate shower bath completed the interior arrangements. Outside, for the observation of wildlife, was an open balcony on which we immediately set up our motion picture camera. Somewhat higher up in the tree a little platform had been built to make possible a view across the surrounding countryside.

For some time after our arrival no animals appeared. However, the sun was still high when, from the small upper platform, we plainly saw two elephants in an open spot in the near distance, feeding on the branches of small trees. And the light was still good enough to take some motion pictures in color when a handsome waterbuck put in his appearance not far away at the edge of the pool. A doe appeared as well, and a cinnamon-colored bushbuck soon followed. None of them paid any attention to us in the tree. As the sun was setting, four giant forest hogs with four piglets cautiously approached the water, stood there for a bit, and then disappeared silently into the forest. A little later we caught a glimpse of a spotted hyena as he looked hopefully about.

A family of hornbills had their nest in the fig tree and, having long since accustomed themselves to their strange neighbors, unhesitatingly came to the living room window and looked in. Down at the edge of the pool other birds were numerous. As the sun slipped below the horizon and the pool grew dim in the shadows, the whole vicinity was peaceful, with nothing to suggest how many animals were in the surrounding forest.

We were attended in our aerial hotel only by the Assistant Manager and the two native boys, but they formed an entirely competent staff. At the appropriate moment, we were served what British Africa universally calls a "sundowner," followed by a really delicious four-course dinner, served amid such amenities as could never have been expected in such a place. The rooms were adequately lighted by electricity, the source being two automobile-type storage batteries; and on the balcony was mounted a strong electric searchlight, ready to be directed at such nocturnal visitors as might appear.

The stage was certainly well set, but to our disappointment the evening was quiet. The air grew colder, and we began to appreciate the heat of the stove, even though we were within a degree of the equator. Toward midnight, we gathered around its friendly warmth for hot chocolate. Then, since no wild visitors of consequence had appeared, we decided to take a nap. But before this plan materialized, the silence was suddenly broken by a series of prodigious snorts that seemed to come from directly below us.

Here was what we wanted!

We hurried to the balcony and, peering over, saw beneath us a mother rhino and her very small "toto," or baby, while another rhino —larger and probably a male—was snorting, stamping, and moving about a short distance off.

We had not heard them approach, nor had they apparently heard each other until they were close. No sooner had they become aware of each other than they began snorting energetically. They made all sorts of strange noises and shuffled back and forth, each plainly doubtful of the other but not quite willing to settle the matter with a charge.

We flashed the searchlight on them, drawing their attention momentarily, but when the light went out, they resumed their snorts, squeals, and tramplings. Finally, however, they suspended their argument and disappeared into the forest, leaving us surrounded once more with the moonlit silence.

Again we lay down on our beds, but shortly we were roused and brought to the balcony by a new racket below. This time it was a great splashing; and in the light of the moon, which was now well overhead, we could see a big buffalo wallowing noisely in the shallows below us. When the searchlight was turned on him, he lifted his great head and stared upward, but the moment the light was off

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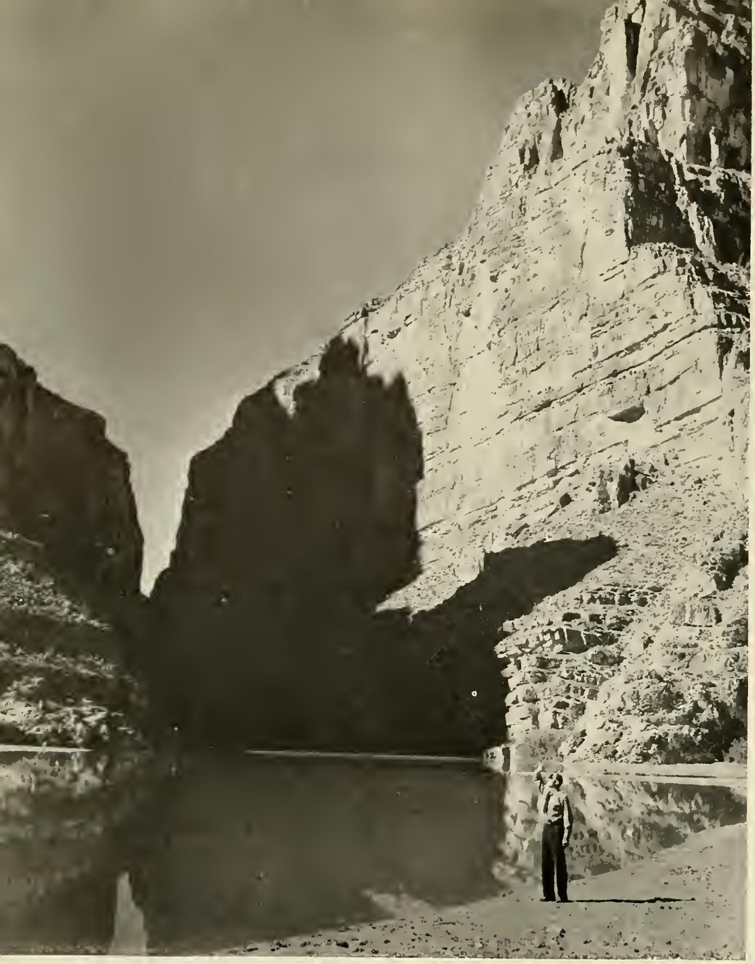

▲ SANTA ELENA CANYON, near the Park's westernmost boundary, with Mexico on one side, the United States on the other. It was at this spot that smugglers and bad men used to slip back and forth across the border

A region rich in the remains of prehistoric animals and entrancing in its spacious scenic grandeur

By SIDNEY ROSS

Photographs by Ross-Pix

BIG NATION

BIG BEND National Park derives its name from the fact that the Rio Grande River, separating the United States and Mexico, makes a huge U-shaped bend in this region. The Park's most magnificent attraction is Santa Elena Canyon, a 1500-foot cleft through which the river flows.

It is said that everything in Texas is big. The Park contains over 1000 square miles and is located in the biggest county in the biggest state. In it has been found the largest known fossil tree (14 feet in diameter) and the largest prehistoric crocodile (approximately 45 feet long). Remains of this creature are on display at the American Museum of Natural History. Dr. Barnum Brown, the well-known dinosaur hunter, discovered this huge animal in 1940. It lived some 70 million years ago and was almost half again as long as the largest living crocodile. Some of its teeth were five and six inches long. Lush semitropical vegetation covered the Big Bend when the giant crocodile lived there.*

The Big Bend has attracted numerous other scientific investigators. Significant discoveries have been made there by the Chicago Museum of Natural History, among others, particularly in the types of mammals that lived 30 to 40 million years ago.

In few other localities can be found as magnificent and rugged a combination of mountain, desert, and river valley. Its mountains, while by no means the tallest or most impressive in the United States, have a special brooding majesty, which causes the visitor from one of the crowded centers of civilization to feel small and humble. Its deserts present tortured vistas of sand and rock, with interesting types of plants growing amid the geological curiosities. Over all

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* See NATURAL HISTORY for May, 1942.

◀ THE TINY Mexican village of Bouquillas, just across the Rio Grande, dozes in the sun. Its dozen or so families and as many dogs constitute the largest Mexican town bordering the entire Big Bend National Park area

▼ OLDEST "RESIDENT" of Big Bend National Park is 107-year-old Gilberto Luna. The ancient Mexican has lived in this region for almost 75 years, and the Government is allowing him to pass his remaining days here. Spry and alert, he makes a living by herding goats and raising corn and chickens

END

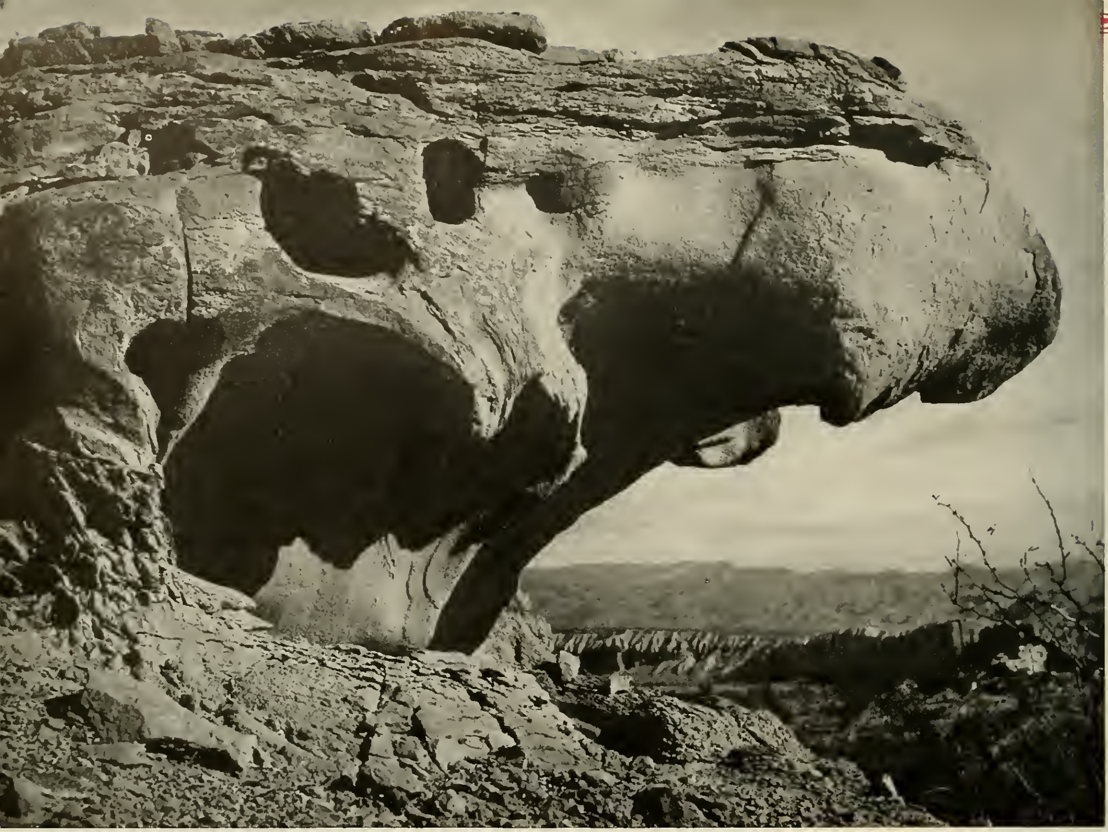
L PARK

of this sparsely settled region hangs a great silence.

The climate of the Big Bend is attractive to those who prefer to avoid extremes. The mountains that ring the location protect it against high winds, and the dry desert atmosphere is generally mild and bracing. Even in summer, the thermometer rarely zooms up to the point where it is unbearable.

Visitors to this Park will find not only all manner of scenic grandeur but also human beings who are every bit as fascinating. Everyone in Big Bend is a personality, from Mrs. Maggie Smith, who runs a combination post office, general store, and primitive health resort, to "river rider" Aaron Green, nicknamed "Noisy" because he was once heard to utter as many as ten words inside of one week. Or perhaps the visitor will want to stop and exchange greetings with 107-year-old Gilberto Luna and his 40-odd grandchildren, or toss off a cold drink with affable Polk Hinson, who presides over a store at the ghost mining community of Study Butte.

Once you come to Big Bend, the rest of the world becomes unreal. Mail comes and goes only once a week, and you don't feel like writing or receiving letters. As you explore this fabled territory, which has been seen by Spanish conquistadores, Mexicans, Apaches, Comanches, cattle rustlers, smugglers, and bad men, the outside world becomes unreal, and you feel yourself slipping under the spell of a land that has witnessed the measureless march of time.



▲ Some imagine it a lifelike serpent with fangs bared. "Rattlesnake Rock" was said by the Indians to have been set up by the Creator to guard Big Bend from intruders

◄ Attractive housekeeping cabins like this one offer comfortable lodging, with kitchen facilities, bathroom, and shower. All were built by CCC boys. But tourist facilities are still inadequate, so write well in advance. You can't phone or wire in the Big Bend

➤ Wildly picturesq
Green Gulch Canyon p
sents a breath-taking pa
rama of loveliness the ye
round. Deer and mounta
sheep can be seen in th
region

◂ RIVER RIDER "Noisy" Aaron Green, whose combined business and social conversation may total ten words a week. As Agent for the Department of Agriculture's Bureau of Animal Industry, he guards the border against the incursion of cattle that may have hoof and mouth disease

➤ WEIRD FORMATIONS like toadstools dot the desert landscape near Terlingua

▲ NEAR BOUQUILLAS CANYON, the turgid Rio Grande divides into three channels, and one can easily wade across the border

▼ BIG BEND RANGER Harold F. Schaafsma, examining a petrified log in the Terlingua area. The log looks like a piece of ordinary wood, but try to lift it! The Big Bend area has produced the largest known petrified tree, measuring fourteen feet in diameter, and there are various semiprecious stones to interest the "rock hound"

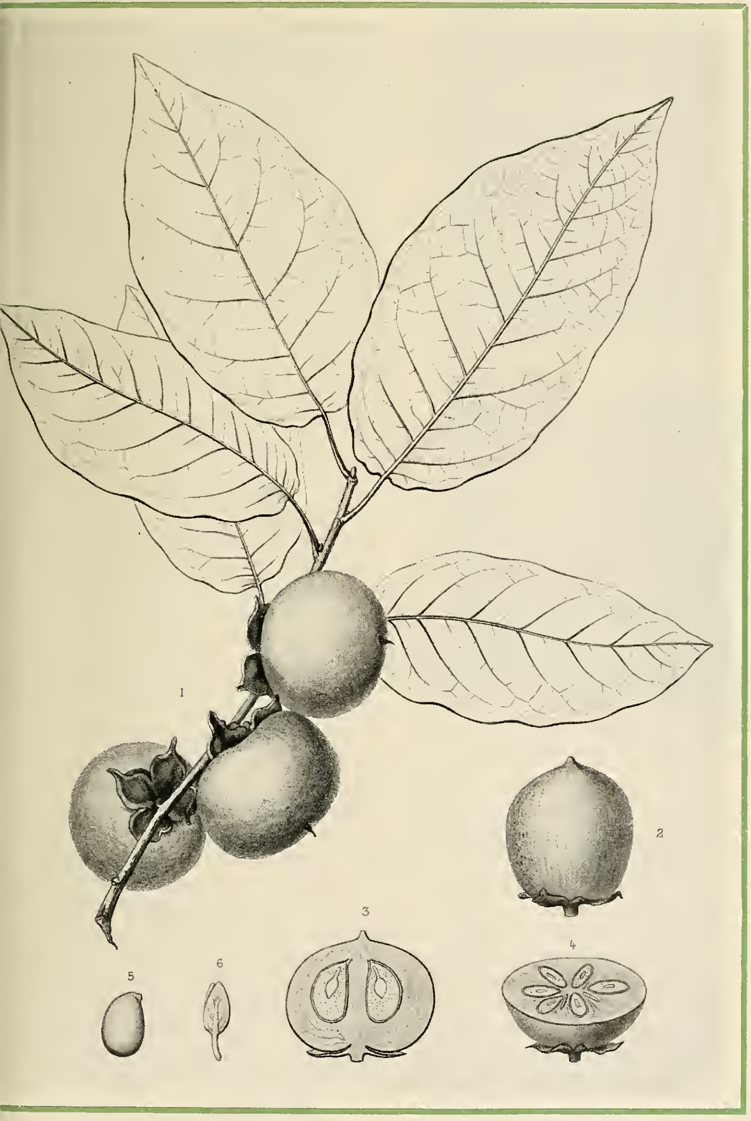
▲ THE GHOST TOWN of Study Butte was once a thriving community. Its quicksilver mines once produced 365 days in the year. Now it is almost deserted, with three permanent residents and a general store that is facetiously called "The Night Club" by Big Bend people

The Persimmon

Its wood, if seasoned, ranks among the hardest and most specialized in use; the fruit, if ripe, is among our softest and most delicious

By Donald Culross Peattie

"IF it be not ripe," said doughty Captain John Smith, of the persimmon he first tasted near Jamestown, "it will draw a man's mouth awrie with much torment." And your own first bite into a persimmon fruit, unless you have been brought up in the region where it is a familiar article of diet, is almost certain to be an unforgettable experience. It will be a day before you can get the puckery taste out of your mouth, and in all probability you will be disposed never to make another trial of the fruit whose name, *Diospyros,* means "Food of the Gods." But that is because most people attempt persimmons before they are truly ripe. At first green, then amber, a persimmon is not ripe until the skin is deep orange, wrinkled, and unappetizing in appearance, and the pulp is so mushy that one cannot eat it without washing the hands afterwards. That stage comes, most commonly, after the fruit has been frostbitten and then warmed by the sun of Indian summer.



By Charles Edward Faxon, from Sargent's Silva of North America

▲ The fruit is "exceedingly austere while green," wrote the celebrated botanist Charles Sprague Sargent, "but luscious when fully ripe"

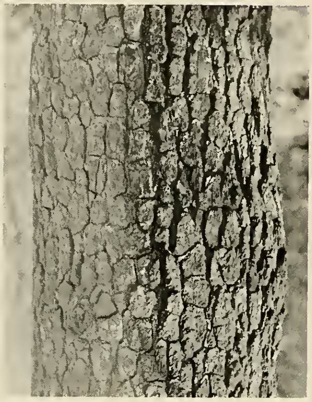
Close relative of the kaki or Japanese persimmon, our native fruit is not so large or handsome or firm of flesh. Yet it is esteemed by connoisseurs, who will travel miles to gather the fruit of a particularly fine tree, and they tell you that the art of eating a persimmon consists (in addition to persuading one's self that a fruit may be a perfect mush and yet delicious) in avoiding the skin altogether, for the intensely tannic taste never leaves that part of the fruit. Certain it is that some trees produce large, some small fruit; some fruits are delicious, some never good at any season; some ripen in August, some in December, and others hold their fruit until spring. Obviously, amidst such variation there are strains well worth propagating and breeding.

During the Civil War, when Confederate soldiers boiled persimmon seeds as a substitute for coffee, Prof. F. P. Porcher published in Richmond a book, *Resources of the Southern Fields and Forests,* intended to show the way to meet the blockade of rebel seaports by

◂ A PERSIMMON TREE at the University of Maryland, bare after yielding the fruit that has made it cherished there

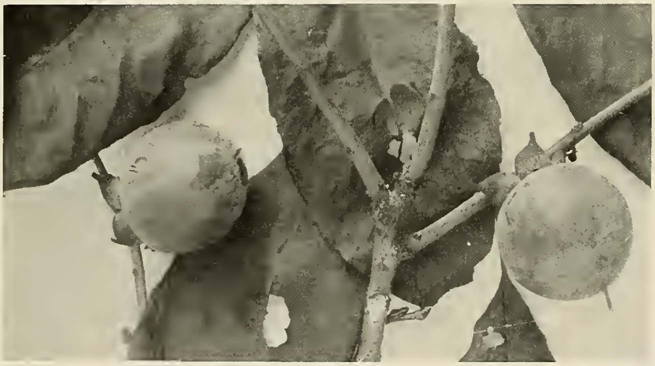
▾ THE CORKY-LOOKING BARK of the persimmon is easily confused with that of the black gum

Arthur C. Parsons photos



▾ THE FRUITS are not so large as the Japanese persimmon, but devotees are reluctant to yield honors in flavor

L. W. Brownell photo



utilizing the native products. In this book he gives as a recipe for persimmon syrup the following:

"The persimmons are mixed with wheat bran, baked in pones, next crushed and put in vessels, water poured on, and all allowed to stand twelve hours. Strain and boil to the consistency of molasses." Porcher adds: "A good vinegar very much like and equal to white wine vinegar is made as follows: Three bushels of ripe persimmons, three gallons of whiskey, and twenty-seven gallons of water. To those who can get the persimmons, the vinegar thus produced will be relatively cheap, even at any price which the elastic conscience can ask for the spirits"—a thrust at war profiteers.

Professor Milton Hopkins[1] tells us how to make a persimmon pudding:

"Three eggs, ½ teaspoon salt, 2 cups sweet milk, 3½ cups flour, 1 qt. seed persimmon fruits, 1 pint cold water, 1 teaspoon soda, 1 cup granulated sugar.

"Wash and seed the fruit (to make 1 quart, about 3 quarts of whole fresh fruit required) and soak them in cold water for about an hour. Then run them through a colander. Mix the other ingredients in the order given stirring thoroughly. Pour the batter into a greased pan and bake at 400° for one hour or until the pudding is a dark brown in color. Serve either hot or cold with whipped cream or hard sauce, and garnish with maraschino cherries. The pudding keeps well in the icebox for several days."

Naturally, persimmons were an important article of diet among the Indians. De Soto was offered loaves made of persimmons by the Indians in the neighborhood of Memphis, and he discovered dried persimmons (called prunes in the narrative) in the villages deserted before his warlike advance in Arkansas. The English naturalist John Bradbury, while traveling up the Missouri, was received among the Osages and offered a bread called *staninca,* made of the pulp of persimmon pounded with maize; he described the taste as like gingerbread.

Le Page de Pratz in 1758 wrote, in his *History of Louisiana,* of the persimmon or *placiminier* of the Creoles that: "When it is quite ripe the natives make bread of it, which they keep from year to year; and the bread has this remarkable property that it will stop the most violent looseness or dysentery; therefore it ought to be used with caution, and only after physic. The natives, in order to make this bread, squeeze the fruit over fine sieves to separate the pulp from the skin and the kernels. Of this pulp, which is like paste or thick pap, they make cakes about a foot and a half long, a foot broad, and a finger's breadth in thickness: these they dry in an oven, upon gridirons, or else in the sun; which last method of drying gives a greater relish to the bread. This is one of their articles of traffick with the French."

But no matter how we humans improve the breed, or cook the fruit, the persimmon will never mean to us what it does in the lives of the wild animals. It is eaten by birds, notably the beloved bobwhite, by the half-wild hogs that rule the Ozarks, by flying squirrels and foxes, by raccoons and skunks and white-tailed deer, and above all by the opossum. According to song and story, most 'possum hunts end at the foot of a 'simmon tree, and when Audubon came to paint his great picture of the opossums, he showed them devouring the strange, puckery-looking fruits, high in the branches of this grand old tree.

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[1] "Wild Plants Used in Cookery," New York Botanical Garden *Journal,* vol. 43, pages 71-76, 1942.

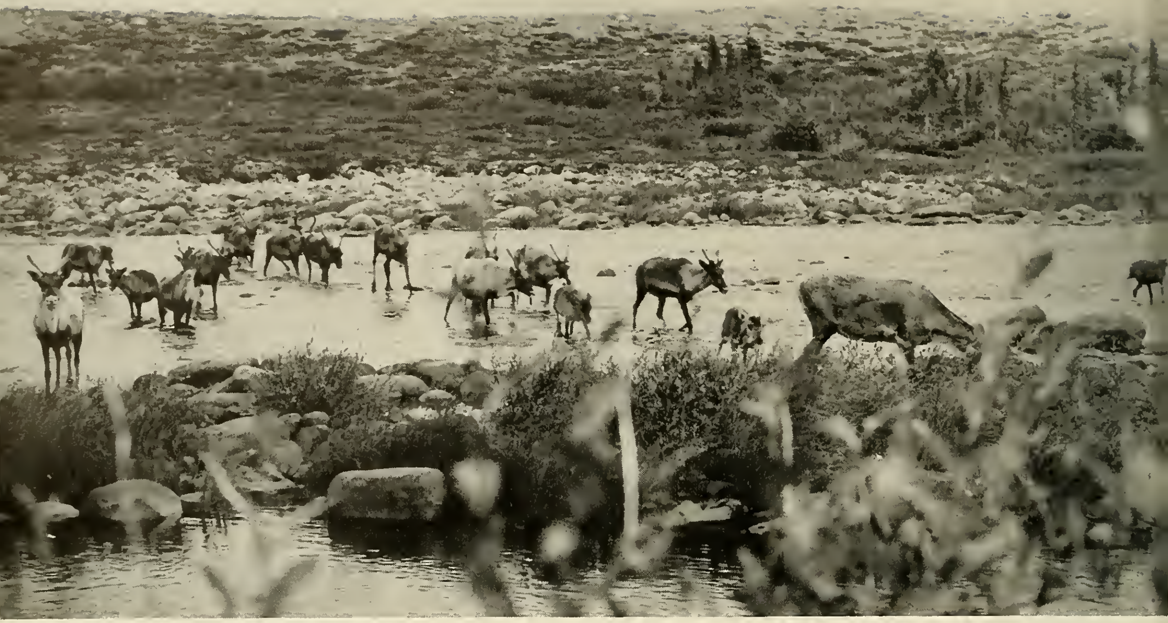
Anyone can name a persimmon when it is in fruit; but in its winter nakedness or its heavy summer greenery with those dark, gleaming, tropical-looking leaves, the tree is not so easy to identify. From its leaves, it is apt to be confused with the black gum, and both trees have deeply furrowed and cross-checked bark. But black gum bark has rather regular narrow ridges cut by remote cross checks, while the bark of the persimmon is irregularly broken into countless small blocks; it has a distinctly reptilian sort of corky hide. In winter, the naked persimmon is revealed as a not very graceful tree, with short crooked branches and fine crooked twigs; and in autumn, the leaves fall very late in the season without turning the gorgeous colors of the black gum. But in the first hot weather of summer the flowers appear, and all that is tropical-seeming about this member of a very tropical family is expressed in the blossoms. True, the waxy-white flowers do not make a brilliant show (they are too small for that and are overtopped by the foliage); but they breathe forth from their thick, jug-shaped corollas a heavy perfume that is the very spirit of the southern summer.

The persimmon often forms dense thickets on dry, eroded slopes. Not only has the tree a deep taproot, but it sends out long stolons or subterranean runners, which are both wide-spreading and deeply penetrating. Trees grown from stolons, however, are apt to be shrubby and are very difficult to eradicate once they have penetrated the soil of an abandoned field. The finest trees, from the point of view of wood production, are, or were, those growing under primeval forest conditions where competition with other trees has forced them to their maximum growth of 100 or even 130 feet in height. Of course the fruit on such a tree is unhandy to pick, and the gatherer of persimmons greatly prefers the dense bushy thickets that spring up on the sides of gullies and in old fields. Although not a fast-growing tree, the persimmon begins sometimes to bear fruit at an early age. It succeeds in the most adverse sites—on the coal lands of Illinois stripped of all the topsoil, or in bottom lands where the water may stand for several months. A more adaptable tree would be hard to find, and the extent to which it is cherished in southern farmyards would make one think it common. Actually it seldom occurs in pure stands, and as soon as the lumberman tries to find specimens suitable for cutting, he discovers that, wide though the range of this species, it is not individually so very numerous.

Persimmon belongs to the same genus as ebony (*Diospyros Ebenum*) of the Orient and betrays the relationship in its heartwood, so dark a brown as to be nearly black. This, however, sometimes does not develop until the tree is over a century old; the very thick sapwood is a pale brown. Persimmon belongs in the class of the very strong woods and is surpassed in our sylva only by honey locust and black locust. When green, it is not so very hard, but no other wood gains more in hardness when it is well seasoned; it falls in the class of the extremely hard woods, as hard as mountain laurel and surpassed only by ironwood and dogwood among the woods of our northeastern states. In weight it is in the very heavy class. It shrinks greatly in drying and will crack unless the ends are protected by paint or parafin. Difficult to glue, it is never used in built-up or ply or fabricated wood; but when once seasoned properly, it retains its shape to perfection. The more it is used the higher and glossier its polish.

Because the trunk is seldom more than a foot in diameter, this tree can never be an article of great commerce, in spite of its valuable properties and the good price it fetches. Its strength as a beam cannot be utilized because of the rarity of dimension timber; indeed, persimmon is commonly sold by the cord. Almost all woods of any value find special employment for which their properties fit them uniquely, and so because of the hardness, smoothness, and non-warping qualities of persimmon, its chief use is for the making of shuttles for textile looms. Some woods, valuable in many other ways, cannot endure an hour under the terrific wear of the looms without cracking, splitting, or wearing rough; persimmon, like apple and dogwood, can endure 1000 hours of furious activity in the mills. Because it stands wear so well, it is employed in the lasts of children's shoes, but it is too expensive for use in shoes of adults whose styles in footwear change often. The heartwood has been used extensively for the heads of golf clubs because it does not crack under a sudden or impact load and takes such a high polish. It is used for billiard cues and beautiful parquet flooring, and in earlier days spinning wheels were made of persimmon wood in the South.

The name of persimmon is old; the Lenape Indians, with whom William Penn treated, called it *pasimenan.* But older still is the geologic ancestry of this tree. Fifty-five million years ago, when the ancestors of the horse were small and short-legged as ponies, persimmons of numerous species were widespread in North America. What is now the ranch country of western Oregon, for instance, supported an extinct species (*Diospyros oregana*) whose closest living relatives are now in Java. But many changes in altitude and climate have swept the ancient persimmons from the West, and today this single species, within the circumscriptions of our northern sylva, lives on, as much a reminder of a far-off time as the opossum, our only remaining marsupial.



▲ TWENTY CARIBOU crossing a rapid on Little River. A typical Barren Grounds ridge lies beyond, with dwarf birch thickets and small black spruces scattered over its slopes

In Caribou Land

Exploration in one of the least-known sections of Canada, where the timber meets the tundra

By FRANCIS HARPER

Photographs by the author

FIRSTHAND acquaintance with the Barren Grounds of northern Canada and their foremost animal denizens, the caribou, had been one of my most cherished objectives for nearly 40 years. Meanwhile, I had pored over the accounts of these animals by such explorers and naturalists as Samuel Hearne, Sir John Richardson, the Tyrrell brothers, Buffalo Jones, Warburton Pike, David T. Hanbury, Edward A. Preble, and Ernest Thompson Seton. At the same time my attention was becoming strongly focused on Nueltin Lake, lying across the Keewatin-Manitoba boundary. This hundred-mile-long lake had been crossed in 1770-71 by the intrepid Hearne, but it had remained unvisited by any professional biologist during the ensuing century and three-quarters. Even on the latest official maps it was represented merely by broken lines. For an average distance of some 200 miles in nearly every direction there extended, until very recently, a general vacuum in biological information—north to Yathkyed Lake and the Thelon River, west to Lake Athabaska, south to Reindeer Lake, and east to Hudson Bay.

A presentation of this state of affairs to the Arctic Institute of North America led to a grant-in-aid from that organization, with support from the Office of Naval Research.* The way was finally clear to Nueltin Lake and its caribou. When I arrived at Churchill in the latter part of May, 1947, the backward season still offered a chance for a plane to utilize the frozen lakes as ready-made airfields. Eaves-high snowdrifts and wintry blasts seemed to say that spring was far behind. An Army bulldozer cleared a way through the drifts, and on the last day of the month our twin-engined Anson took off, with Johnny Bourassa in the pilot's seat.

The entire route to Nueltin Lake, 250 miles to the northwest, was over a varying mixture of tundra and patches of small spruce and tamarack—an unbroken wilderness save for the Hudson's Bay Company post at Duck Lake, where we were to stop briefly for refueling. Under Johnny Bourassa's skillful navigation we made the post "right on the beam" and landed nicely. Caribou-eater Chipewyans promptly hitched up a dogteam and hauled several drums of gas from the warehouse. Beyond this point it was altogether new territory for the plane's crew. Our problem was to locate the little Windy River trading post at the northwestern extremity of Nueltin Lake—a veritable needle in a haystack. Toward the end our course might have been likened to that of a mariner seeking a haven on an unknown coast. Close to the Magnetic Pole the compass becomes uncertain, and even the most seasoned pilots seem to have exceptional difficulty in finding their way over the Nueltin area. When we arrived over what appeared to be the northeastern arm of the lake, it was difficult to distinguish between the snow of its frozen surface and that of the surrounding tundra. We were seeking a range of hills on the south side of Windy Bay, which we hoped would guide us to the cluster of log cabins belonging to the Schweder brothers. When the search was beginning to look more and more dubious, Johnny made a sudden turn, and a few minutes later we saw a small tower rising from a group of cabins half hidden in snowdrifts at the mouth of Windy River. He brought the plane down on the bumpy surface of the near-by bay, and we reached the camp to find it silent and unoccupied.

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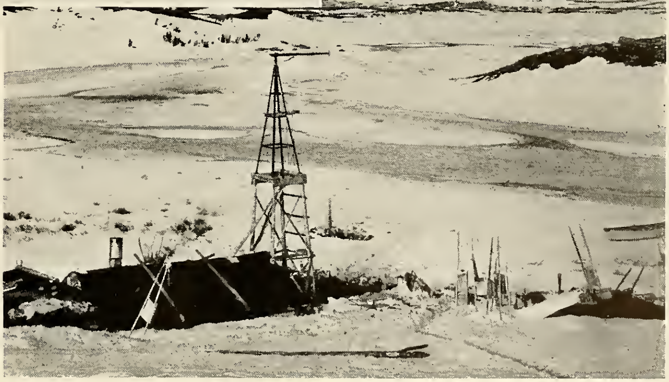
In Churchill I had received an invitation to make this camp my headquarters for the season. It was being maintained as a trapping center and trading post by two brothers, 22-year-old Charles Schweder and 17-year-old Fred. Their nearest neighbors and principal customers are a small group of Padlimiut Eskimos, whose camps are on or near the Kazan River some 60 miles to the northwest. They also do a little trading with some caribou-eater Chipewyans who live about the south end of Nueltin Lake. They themselves derive sturdy qualities from Cree forebears.

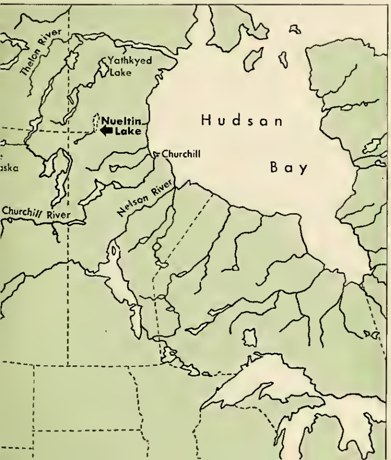
In late afternoon the plane took off for Churchill. Then began a several days' task of portaging outfit and provisions over a rugged quarter-mile to the camp. Meanwhile, I set up a skinning table beneath a little window in the three-room log cabin and by degrees got into the swing of the season's biological operations in a marvelously fascinating environment.

On the third day the door opened softly behind me, and there stood a six-foot-three, 190-pound giant looking upon me with some wonderment in his eyes. A few words of explanation, a letter of introduction from Churchill, and Charles made me welcome for the season. The unostentatious, thoughtful hospitality of that household is a treasured memory. Charles had just then returned from a trip by dogteam to his Eskimo friends on the Kazan. He had cov-

◄ Flying out of Churchill on Hudson Bay, the plane deposited the author and his equipment on the ice at the northwest extremity of Nueltin Lake, on the last day of May. Left: plane mechanic Don Gallagher; right: pilot John M. Bourassa

▼ Snow still lay eaves-high around the cabins of the Schweder brothers —traders, trappers, and travelers extraordinary—with whom the author made his headquarters





▲ **Solitary camp** on Josie's Bay. The author passed a delightful week here in July, when the midsummer lull in the caribou migrations permitted him to turn his attention to plants, fishes, and birds

▲ **Summer repairs**: new roof-paper for the Windy River Post, with fresh-cut grass beneath. In a few months, only the tower and the smoke pipe will mark the location of the cabin beneath the snow

ered the 60 miles in some 18 hours, making only three one-hour stops to "boil the kettle."

Several days later the other members of the household returned with another dogteam from the south end of Nueltin Lake. First among them was Fred, a keen Nimrod, trapper, and fisherman, with a quiet smile and a voice so soft as to be little more than audible. Next was his ten-year-old brother Mike, who proved to be probably the best all-round cook of his age in the length and breadth of Keewatin; he performed yeoman service in the kitchen whenever we two were left alone in camp.

The remaining two members were the first Eskimos of my acquaintance—a fifteen-year-old boy, Anoteelik, and his five-year-old sister, whose original name had been shortened to Rita. Their presence on the Windy River was wrapped up in a tale of stark tragedy on the Barrens to the north; it was at the same time eloquent testimony to the great-heartedness of Charles Schweder. The Eskimos are notoriously happy-go-lucky, with little more thought of the morrow than the grasshopper of Aesop's fable. From time immemorial the Padlimiut have depended upon the migratory throngs of Barren Ground caribou (*Rangifer arcticus arcticus*) for their main sustenance. They know from experience that these animals follow a general pattern in their spring and fall migrations; but these movements are so variable that no man may say with any degree of certainty just when or in what numbers the caribou will appear in a given locality. So, in the fall of 1946, the Kazan River band lost their gamble on the coming of the *tooktoo;* all but the merest fraction of the usual thousands passed the upper Kazan to one side. By the next spring eight out of the band of 27 had met a grim end by starvation. All the victims were women and children; the men and even some of the dogs survived. Such is the status of chivalry in this part of Eskimo land.

When Charles reported the situation in March after a 250-mile trip to Reindeer Lake, the government shipped emergency provisions by air as far as Nueltin Lake. From that point Charles hauled them by sleigh to the Kazan. On one of his trips, Anoteelik begged to be taken away. Charles bade him come and take his thin little sister with him. Their own mother had already succumbed. So the children became members of the household on Windy River and flourished thenceforth under Charles's understanding care.

The vast bulk of the local caribou ordinarily abandon the Barren Grounds to winter in the "Land of Little Sticks," stretching away southward to the Churchill and Nelson Rivers. The return movement reaches the north end of Nueltin Lake approximately in early May and continues throughout June. Thus it was in full swing at the time of my arrival. The lakes and rivers, still icebound, offered no impediment to the progress of the caribou. In fact, the animals utilize these open areas for their resting places, where the wide outlook prevents their ancient enemy, the wolf, from making an unobserved approach. During the plane flight from Churchill we had noted three separate bands on the frozen surface of Seal River, the largest numbering about 40 individuals; then a few others elsewhere, including 20 or so on Windy Bay.

Along the south side of this bay the rugged Windy Hills rise rather abruptly to some 500 feet. But the mile-long South Bay, meeting Windy Bay at right angles, affords a convenient break in the hills; and the adjoining slopes are negotiated readily by the caribou. So here they converge from the neighboring heights, making long, slanting trails through the snow. They pass out of the mouth of South Bay as through a funnel, then follow a regular path across Windy Bay, until they are lost to view among islands or on the limitless Barrens to the northward.

Until the "break-up" occurred in mid-June, bands were seen almost daily following this line of march. The numbers in each might be anywhere from 3 to 75. They traveled in long files and yet not altogether in a single file. For the most part they progressed at a moderate walking gait. One morning most of a band of 25 were lying down on the bay ice, while a few remained standing.

Besides resorting to the frozen lakes and rivers for their resting periods, the caribou will select some commanding hilltop for the same purpose. About 75 appeared in midday on a rocky knoll on the far side of Windy River. While some kept on feeding, many lay down on snowbanks, apparently preferring these to the plentiful patches of bare ground. In the variety of their attitudes on this height, the animals were disposed perhaps more like alpine chamois than like the generally conceived masses of caribou on the low Barrens. What a subject for a John Guille Millais!

The higher elevations may serve for the nocturnal rest as well. On June 20, for instance, as the setting sun was casting a wonderfully clear and golden light on the imposing hill beyond the junction of Windy and South Bays, two separate bands of twelve to fifteen caribou were making their way toward the broad, plateau-like summit. These movements may have indicated an urge to spend the semidarkness of the summer night on some high, open area offering a good lookout for wolves.

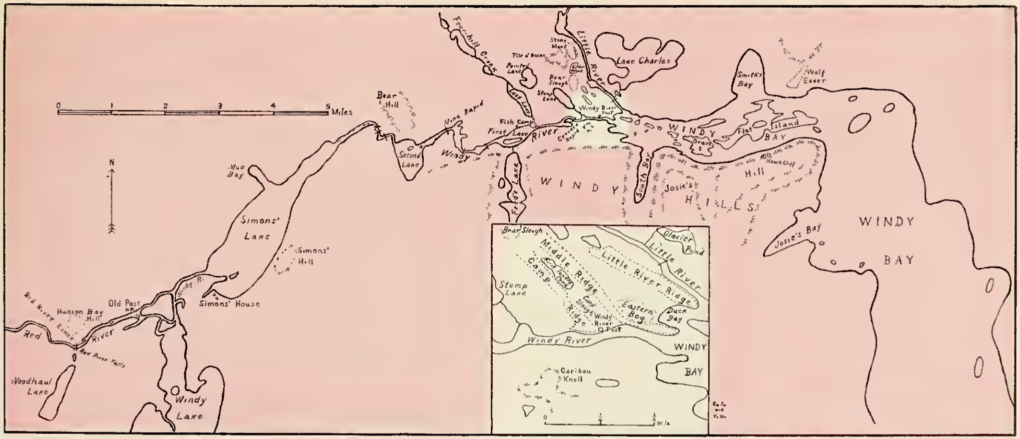
When the bay ice began to break up in June, the caribou were forced to pass around the bay and swim across the Windy River. Our camp, a few hundred yards up the river from its mouth, was strategically situated in their migratory path. Time and again bands would appear on the hillock opposite us. Some retreated at the sight of some movement in camp or in consequence of the ululations with which ten Husky dogs greeted their appearance. Others, however, with astonishing indifference, plunged into the river and made their way rapidly across. On at least one occasion, several landed literally in our dooryard, only to splash madly away as I came forth to film them.

So the migration continued, in gradually lessening numbers, as summer came with a rush to the Barrens. On July 1, the final band of caribou passed our camp. During the early part of this month the animals keep advancing, till they have practically deserted the southern Barrens. Meanwhile, the does bring forth their fawns on green arctic pastures far up toward the continental limits. Presently the augmented hosts take up their southward march—the mightiest, most imposing phenomenon still to be witnessed among the land mammals of North America.

By the end of July an air of expectancy pervades the camp. "When will the caribou come?" is the thought in every mind. The hunters roam the Barrens or occupy some lookout post on high ground. But July passed, and the first few days of August; and still not a solitary buck appeared on the horizon. It was not until the sixth that Fred brought in a hind quarter from the first buck. That meant rejoicing in camp; Mike was grinning from ear to ear, and the two Eskimo kids were talking to each other about the forthcoming feast. Charles and Anoteelik went off with pack sacks and returned with meat for the hungry dogs.

The normal pattern of fall migration in this area, as explained by Charles and Fred, is somewhat as follows. The caribou generally return from the north about the first of August. Bucks are likely to form the advance elements of the fall migration as well as the rear guard of the spring migration; this suggests that they may not go so far north as the does. The forerunners come in small and very gradually increasing numbers, until presently a big movement, composed of perhaps thousands of individuals, will pass by in three or four days. Oddly enough, there is generally a definite retrograde movement northward into the Barrens sometime in September. Occasionally considerable numbers may remain there during the winter. In most years, however, the final passage into the timbered country may occur in November, and perhaps the largest herds of the year will then be seen.

Even by mid-August only a few caribou had appeared. On the 20th, however, Fred reported about 300 of the animals moving in our direction across the Barrens north of


0
1
2
3
4
5 Miles
N
Four-hill Creek
Pile o' Rocks
Pointed Lake
Stony Mound
Little River
Lake Charles
Bear Slough
Stump Lake
Last Lake
Bear Hill
Mink Rapid
Fish Camp
First Lake
Windy River Post
River
Crooked Rapid
Windy
Second Lake
Mud Bay
Simons' Lake
Simons' Hill
Windy R.
Simons' House
Old Post
Hudson Bay Hill
Red River Esker
Red
River
Red River Falls
Woodhaul Lake
Windy Lake
Fred's Lake
WINDY
WINDY
Flat Island
BAY
Grave
South Bay
Hawk Cliff
Hill
Josie's
HILLS
Smith's Bay
Wolf Esker
WINDY
BAY
Josie's Bay
Bear Slough
Middle Ridge
Camp
First Tundra Pond
Little River Ridge
Glacier Pond
Little River
Stump Lake
Camp Slough
Ridge
Eastern Bog
Duck Bay
Windy River Post
Windy River
WINDY
BAY
Caribou Knoll
0
1/4
1/2 Mile

▲ AUTHOR'S SKETCH MAP of the regions around Windy River Post, at the northwest extremity of Nueltin Lake

◂ THE STRANGELY-ASSORTED "FAMILY" at Windy River: the zoologist with a dip net, Rita with a rag doll, Fred with a Winchester, Mike with a game bag, and Anoteelik with a caribou spear

▾ RITA looks on while Fred and the zoologist prepare a caribou skin. Old hides nailed to the logs of the earth-banked cabin help keep out the winter cold

Windy Bay. On the same afternoon I enjoyed a glorious spectacle from "Pile o' Rocks," a lookout point northwest of camp. Only a couple of miles to the south the imposing Windy Hills shut off the view, but in other directions my gaze swept over the unending Barrens for distances of 10 to 25 miles before other hills rose to mark the horizon. Two rivers, two sizable lakes, and tundra ponds almost without number were visible in this expanse of some 400 square miles. Off to the eastward, beyond Little River, several groups of caribou, numbering from 3 to 20 or 25 individuals, were feeding quietly. Their fresh dark autumn coats showed up much more conspicuously than had the cream-buff of their winter coats in June.

Presently the scene became livelier, as the largest band, composed of does and fawns as well as lordly bucks with enormous antlers and white manes, started to romp across the Barrens. The mosquitoes and black flies, which harry the animals throughout the summer, may have gathered in hordes beyond the limit of quiet endurance. Or one or the other of the two kinds of parasitic flies that bring year-long misery to the caribou may have been on the rampage. The larvae of one burrow beneath the skin of the victim's back and become the disgusting warbles that are found in numbers up to a couple of hundred on a single animal. The other fly deposits its eggs in the nostrils, and the resulting larvae infest the animal's throat. Both parasites scourge their victims from one summer to the next. The caribou instinctively fear the adult flies; they may endeavor to fend them off by an extraordinarily vigorous shaking of their sides and head, or they may simply stampede in the vain hope of outdistancing their tormentors. Thus the sight of rapidly trotting caribou becomes a familiar one, until September frosts put an end to the winged pests.

As the eye swept farther over that silent, lonely land, still other caribou were disclosed singly or in groups scattered here and there over a couple of square miles. There was no strong herding instinct as they grazed at will. Even when on the march, they straggled along, some as much as 10 to 20 yards apart. After a couple of hours, the movement reached a lull; the lowering sun and the cooling atmosphere, with a lessening number of black flies, indicated that it was time to turn back to camp. Never before had I so fully realized my dream of watching these wonderful creatures in the wild freedom of their arctic home.

The far-roaming caribou put their mark on the land to a greater extent than any other North American mammals of the present day. The hoofs of generation after generation have beaten trails and kept them open, till there is a network perhaps millions of miles in total extent over the whole Barren Grounds and the adjacent timbered country. They are especially in evidence on the long gravelly ridges in the Barrens. It is vastly exhilarating to a naturalist to direct his own course along these ancient, well-marked paths.

On the afternoon of August 24, Fred came into the cabin and announced "a bunch o' deer" (as caribou are called in the North) moving along a ridge on the east. With movie camera and tripod in hand, and keeping under cover of the small spruces that grow in the low ground between the ridges, I came up with several bucks as they emerged into a small open bog. A few moments later a lone, inquisitive, one-horned doe appeared in another part of the bog and began to come closer. While engrossed with this animal, I caught a movement out of the corner of my eye, and there the bog was full of caribou! They had evidently come up behind me and now stood only about 50 yards away. I was absolutely in the open, with not a vestige of cover between me and the 75 to 100 caribou. This herd was composed very largely, if not wholly, of bucks. Quite unconscious of their own power, they could have, if so minded, utterly demolished me under their hoofs in a few seconds' time. It was an extraordinarily gratifying experience to have arrived at such intimate terms with these magnificent, peaceable denizens of the Barren Grounds.

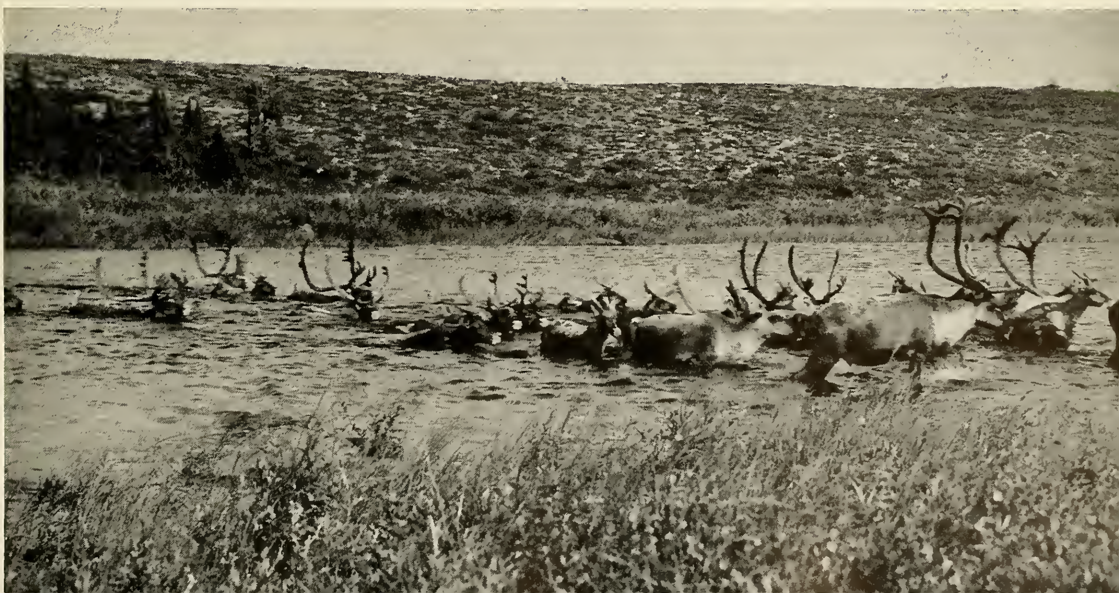
After a spell of rain that halted camera operations, I returned to the same bog and presently filmed a band of 17 caribou as they ambled unconcernedly along the edge of a tundra pond, without even looking in my direction. Then the largest herd of my whole season's experience, numbering perhaps 150, passed along a ridge on the opposite side of the bog. A heavily maned patriarch brought up the rear of that superb throng. Like various other individuals observed from time to time, he seemed to be limping slightly, perhaps from old wounds. The natives make a practice of seeking out the older bucks, not at all for the glory of their antlers but simply for the extra-thick fat stored beneath their hides.

August 25 was a gala day on Little River. My first station was on a rather open slope, among clumps of dwarf birch, with a clear view of the crossing place at the rapid. A temperature in the 40's, with a brisk northwest breeze, suppressed the black flies. While waiting for the caribou to come into sight across the river, I could drink my fill of the rolling, drumlin-like, rock-studded Barrens, with little thickets of dwarf birch struggling up the slopes and copses of small spruce and tamarack scattered along their bases. On the near side of the river was a fringing strip of willows, up to ten feet high, through which the caribou had made numerous trails.

The animals came along at intervals from the eastward, in bands up to 75 strong. The big movement was definitely under way. A small number might make the crossing in one or two files, but one of the larger bands might spread out widely. The towering antlers of an occasional patriarch nearly doubled his stature. In buck and doe alike, marked asymmetry in the main beams of the antlers was common. Some of the does were one-horned, and some altogether hornless. Although summer was nearly over, many of the does still retained a large part of their previous winter's coat. Here at the rapid the adults walked across on the rocky bottom, but the fawns were obliged to swim in the deeper parts.

The larger the band, the less heedful the animals were of possible danger. It was evidently a case of each individual depending for its safety on the sheer numbers about it. How different, on the other hand, was the attitude of a single doe, accompanied by her fawn. In approaching the river, she would look

▼ A BAND composed chiefly of big bucks, crossing Little River. When seen head-on, their white-ringed snouts give a comical touch to these majestic creatures. The antlers will not lose their velvet until mid-September



long and carefully, both upstream and down, for any possible lurking foe. Instinct bade her take these precautions in behalf of her heedless offspring. The fawn was obviously entrusting everything to its circumspect dam; its only concern was not to be left behind. But the manner in which her scrutiny passed right over the motionless human figure in plain view on the opposite bank might have been tragic indeed under ordinary circumstances. It was perhaps the difficulty of keeping close to the does at the river passages that led the fawns at such places to give frequent voice to their curious, explosive grunt—a raucous *gwuf* or *gorr.* Perhaps it is equivalent to calling, "Where are you, mammy?" or "Don't leave me behind!"

As the caribou emerge from the river after swimming across, they shake the water off their coats in a cloud of spray. They may begin as soon as their bellies are clear of the shoal water, and they may repeat the process a couple of times as they climb up the adjoining ridge. The action is much like that of a dog under similar circumstances. The shaking includes not only the body but the head, ears, and tail.

Each day's vigil on Little River brought delightful experiences. August 26 was marked by mist squalls and a maximum temperature of only 45°, and there was a slight slackening in the caribou pageant. But on this and the following days I continued to enjoy unusual opportunities for studying the animals at close quarters. Especially when the afternoon sun shone on the glistening autumn coats of the bucks, does, and fawns was the broadside array superb. They would pause now and then to watch me crank up the camera and only occasionally moved off hurriedly. Then a band of them might climb the steep ridge behind me and halt in picturesque outline against the sky to look at the strange figure below them. At one time, three or four mighty bucks were grouped at the water's edge in a pose fit for a Landseer's brush. Such scenes represented life on the Barren Grounds in one of its most enchanting aspects. In this caribou Elysium I felt that the field experiences of a lifetime had soared to an undreamed-of climax.

From in front the swimming animals present a curious appearance. There is a whitish ring around the end of a dark snout, strongly suggesting the white lips of a black-faced comedian. On land, the whitish patches just above the hoofs, resembling spats, give a dainty touch to the trotting caribou. In the water, they are so buoyant that the entire line of their backs, including the tail, projects above the surface. The tail points straight into the air, except that the very tip droops backward a bit. The heavy antlers of the bucks force their heads a little lower, so that the under side of the jaws just touches the surface, whereas the does keep their whole heads out.

Every caribou has a curious gland in each hind foot, opening in the cleft between the hoofs and supplying an oily secretion to the hairs adjacent. Apparently one of its functions is to anoint the soft, growing tips of the antlers while they are in the velvet stage. A strange habit of leaping into the air when starting off in sudden and perhaps panicky flight has been connected with this gland by A. Radclyffe Dugmore. He concluded that these frightened leaps expelled the fluid from the foot glands and that it served as a warning signal, for every caribou arriving at such a spot, even hours afterwards, would start violently and run off with every indication of fear.

While watching the animals on the Barrens, and especially at the river crossings, I had exceptional opportunities to glean information on their feeding habits. During the warmer months they showed a distinct preference for fresh green foliage and herbage. Apparently it is mostly in winter, when these things are no longer to be had, that they turn to their traditionally staple food, the so-called reindeer "moss." Charles said that he had seen them digging through four feet of snow in winter to reach the reindeer moss beneath. This is actually not a moss but a lichen—or rather several species of lichens of the genus *Cladonia.* These grow everywhere over the Barrens and far down into the wooded country where the animals range in winter. They are creamy or pale grayish in color, with a slight greenish cast. In their intricate branching shapes they are distinctly appealing to the eye; especially a certain species (*C. alpestris*) that grows in the form of numerous little coalescing domes.

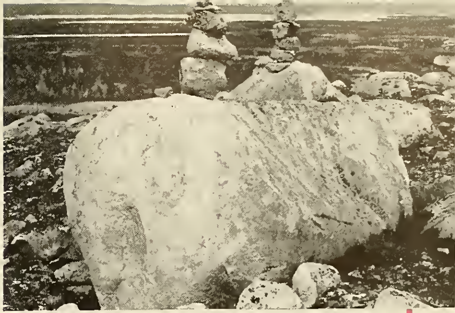
In summer, when the sedges and grasses shoot up in the bogs, the caribou may be seen grazing there. Among the deciduous shrubs, they are distinctly fond of the leaves of dwarf birch, and they likewise nip off the terminal twigs, which they share with the ptarmigan and the Arctic hares. They browse contentedly in the willow thickets bordering the rivers, and they also partake of alder. In August and September, when mushrooms of various shapes, sizes, and colors enliven the Barrens, the caribou feed upon them to such an extent that the Eskimos give these plants a name signifying "caribou food."

It was interesting to notice that when a band of half a dozen lay down in the open to rest and presumably to chew the cud, each of them faced *down wind.* In this position their eyes would inform them of any enemy coming from that direction, while their noses would serve for the opposite.

Among all the caribou killed locally, only a small proportion of the hides are prepared for domestic use, and practically none reach the fur market. The children of the camp generally take over the task of drying them. With head and legs cut off, most of the hides are stretched taut and pegged out on the ground, fur side down; a few are nailed to the outer wall of a log storehouse. Eventually they are used for winter clothing, blankets, sleeping bags, upholstery, and tent material. Those with the fresh, short pelage of early autumn, before the long winter hair has reached its full growth, are the ones in demand.

Aside from primitive man, the only other considerable predatory foe confronting the Barren Ground caribou in ages past was the wolf.

▲ Three hardy Chipewyan Indians come from the south end of Nueltin Lake for trading in late October. They had prepared themselves for the freeze-up by bringing a toboggan and several sled dogs



▲ "Stone men" are set up along the ridges by Eskimo and Indian hunters to turn the migrating animals toward a strategic location. A single pile may also be put up to guide a hunter back to his kill

▲ Zero weather on the last day of November, a rocky ridge in the Windy Hills, where white spruce sentinels withstand the blasts of the arctic winter

▼ Fred, just in from the Barrens with a load of caribou meat: a typical November scene at remote Windy River Post, where the Schweder brothers have fashioned an unusual but happy existence in the wilderness

Neither of these had any serious effect on the size or condition of the herds. In fact, the wolf, by eliminating the weaklings, the sickly, and the less alert individuals, may be safely considered a benefactor of the species as a whole—a regulator and preserver of its vitality. Up to a century or two ago, when the baneful effect of civilized man began to be felt, the caribou throve and multiplied to a point where they probably strained the grazing capacity of the Barren Grounds. They were numbered by millions and doubtless owed their vigor and their success as a species in no small measure to their friendly enemy, the wolf. By way of testimony on this point, we may cite the only two regions of the world where caribou do not share their territory with the wolf—Spitsbergen and the Queen Charlotte Islands. Instead of thriving in the absence of such a natural predator, the animals of both regions are the runts of the whole caribou tribe, and those of the Queen Charlottes are perilously close to extinction. The lesson is obvious: it is folly for man to imagine that he can benefit the caribou by eliminating the wolf.

It is virtually axiomatic that no predatory species (other than man) exterminates its own food supply. Long ago nature must have established a fairly definite ratio between the populations of the wolf and the caribou. Although a certain fluctua-

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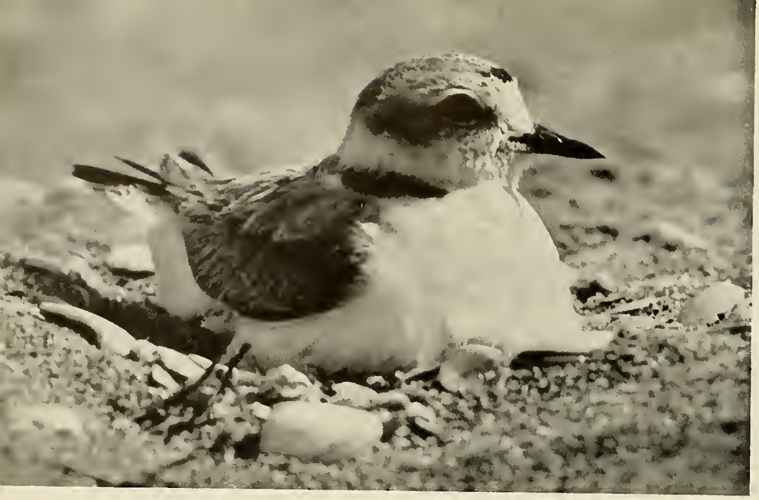
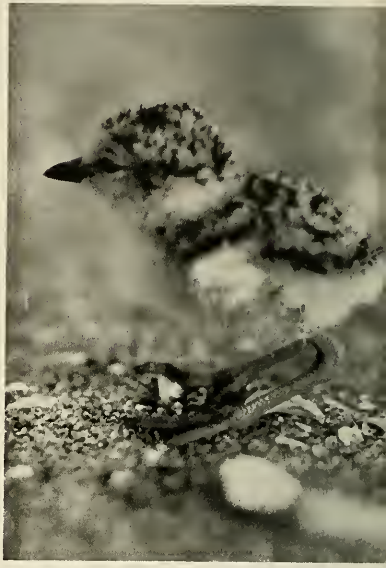


◄ A CHICK'S-EYE VIEW of a bird you may pass unnoticed on the beach because of its effective natural camouflage

▼ A YOUNG SNOWY PLOVER, which could not wander far without evoking serious anxiety in its parents



Beachcombers

The snowy plover is a distinguished camouflage artist and a born master of diversion strategy

By LEWIS WAYNE WALKER

Photographs by the author

THE snowy plover, most beguiling bird to be found on a Southern California beach, has been called a variety of names, but none of them are derogatory, because the adjective "cute" is used as a prefix for all. Offhand, I feel that the snowy is the only beach bird that really fits this overworked word.

Every mannerism, whether executed when there is need to lead an enemy from the nesting area or performed while procuring food under the lip of a crashing breaker, has a certain something that seems to separate these birds from ordinary shore-line feeders. Perhaps it is their two-tone finish—immaculate breast and sand-colored back—that magnetically draws the interest of folk who normally show no interest in birds. Perhaps it is their absurdly round, egglike shape and seemingly inadequate legs. It could be their precision of movement, for motion alone makes the bird visible, while rigidity creates a perfect blend into sandy surroundings. To many sun-tan addicts these "now-you-see-it, now-you-don't" maneuvers are startling examples of protective coloration. The bird unconsciously utilizes plumage in a successful struggle for survival on exposed terrain where there are no hiding places.

Their choice of nesting sites is clear proof that the snowy plovers depend upon deception, and their abundance on beaches crowded with week-end swimmers shows that their deception has been successful. Their eggs, three in number, are placed in a slight depression on the dry sand above the high-tide mark. Sometimes bits of shell, dried seaweed, or other debris are pulled in to form a rim, but such ornamentation is not a "must" in snowy housebuilding. Traceries of black are scrawled over the gray-toned eggs, and if the nest is unmarked, they blend into the sand to the point of invisibility.

For this reason, very few nests are found by accident. Instead, you will locate them after a long wait for the adult to disclose them. However, this wait is far from tedious, because both parents will combine talents that may well entice the watcher away from the area. They employ various ruses, depending on the nearness of the human observer and the imminence of nest discovery. If the birds are only mildly disturbed, their behavior will give the impression that every footprint in the sand is the nesting site, and their solicitation for these empty holes carries real conviction. On numerous occasions, I have been fooled into supposing that a nest had been found when one of the pair stealthily sneaked away from its mate, who was fondling imaginary eggs beneath its feathers.

If the watcher chooses a vantage point close to the real nest, the pantomime of the broken wing will usually be enacted. However, snowy plovers seem a little more consistent than some of the other birds that resort to this act. Killdeer and nighthawks often alternate injuries from side to side and thus spoil the illusion. But the snowys usually "stick to their story" by dragging only one injured member as long as there is a chance that the trick will work.

▲ "SANDY" lying low amid his sandy background

Several seasons ago, near the Mexican village of Ensenada, I located three young plovers that had just come out of their shells. Each of these tiny young could sit on a nickel without overlapping the edges. They seemed to forget their parents' command to "freeze" as I lifted them off the ground, for when replaced on the sand, they scattered at divergent angles. Near by there was a rusted one-pound coffee can, which I buried in the sand as a corral to keep the young together. Then from a distance I awaited developments.

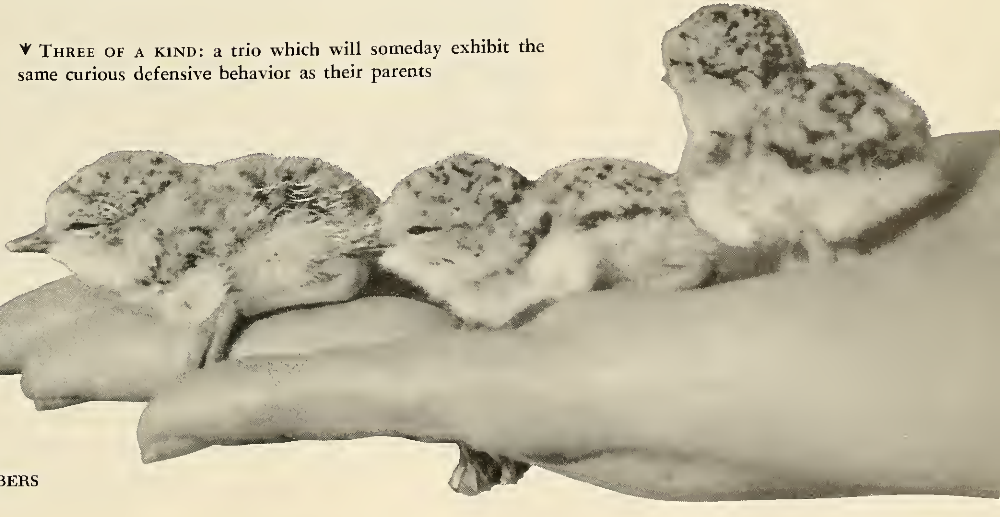
The broken-wing act ceased as soon as I left the vicinity, and the adults flew off down the beach. Five minutes later, however, they stealthily returned in a series of fast runs and dead stops and peered into the buried can. Then, seemingly unperturbed, they walked a score of feet away and started to catch kelp flies and other insects that live on rotting seaweed. Occasionally I could see the head of a young one almost reach the rim of the can in a vain attempt to join its foraging parents.

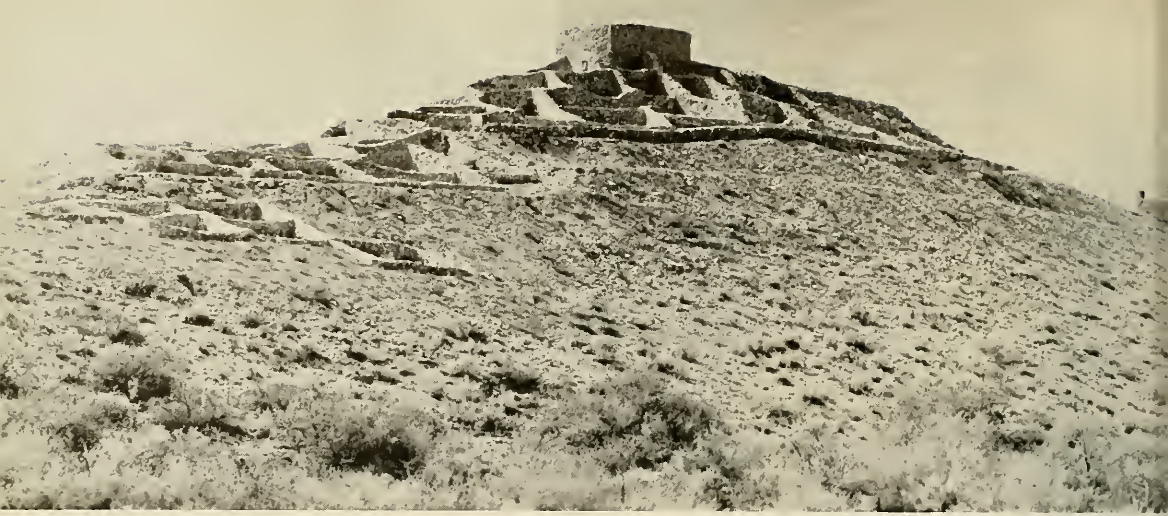
Many more minutes passed before the adults showed by their actions that all did not suit them. Their feeding gradually worked toward their imprisoned chicks, and they made several nonstop runs past the can to look inside. Although I was far out of hearing, I imagine that these trips were made to urge the chicks to greater effort, for each time a parent approached, the young would scramble about in a wild endeavor to reach the sand above. Finally, in the belief that the baffled adults had met a situation with which they could not cope, I thought of freeing the young. And then it happened!

Many will say that what I am about to describe was accidental. The specialist in animal behavior, who usually knows what he is talking about, will argue that controlled experiments do not show that birds are intelligent enough to have been "using their heads." However, no one can object to my recounting what I observed; and I, for one, cannot blame it on instinct or accident.

The adults circled the rim of the can and paused for the first time, on the edge. Presently both started to kick the loose sand at the chicks below. Within several minutes the efficacy of this maneuver became apparent, for the heads of the jumping chicks now came above the tin, and sometimes they almost chinned themselves to the surface. A few more kicks by the adults raised the floor level to a height necessary for freedom, and then the reunited family scurried down the beach.

▼ THREE OF A KIND: a trio which will someday exhibit the same curious defensive behavior as their parents





National Park Service photo

City of the Crooked Water

Like an oasis in a region of famine, the ancient settlement called Tuzigoot flourished, but its fertility seems also to have spelled its doom

By NELL MURBARGER

ARIZONA'S splendid cliff dwellings and pueblo ruins have for two generations been among the state's leading tourist attractions. Some of them—such as Montezuma's Castle and Casa Grande—have become virtually as famous as the Colosseum of Rome, and every season new hordes trail through them and exclaim over them in half-a-hundred languages.

But not all of Arizona's ruins are so renowned. For example, there is Tuzigoot – City of the Crooked Water. While it is one of the state's most readily accessible pueblos and is considered large and of exceptional interest, even by southwestern standards, this is a place all too seldom visited by the casual traveler. Situated in the fertile Verde Valley of north-central Arizona, between Flagstaff and Prescott, Tuzigoot is reached via paved U.S. 89-A to Clarkdale, where a winding, graded road leads across the Verde River to the ruin, only a mile and a half distant.

This is scenic country. To one side rises the huge bulk of Mingus Mountain, with a necklace of copper mines around its throat and at its feet the milling town of Clarkdale. Beyond the town lies a flat, green valley with pocket-sized fields of alfalfa and velvety meadows where fat, red cows and sleepy burros graze and, now and then, a little flock of sheep or goats. Through this pleasant pastoral scene winds the Verde, clear and sparkling, with age-old cottonwoods and willows overhanging its banks.

It is this river that gives the old ruin its name. What the pueblo may have been called by the ancient ones who built and occupied it is something no man knows, but its present name of Tuzigoot—City of the Crooked Water—was given it long decades ago by the Tonto Apaches.

A short distance beyond the river a short, steep rise brings the visitor to the pueblo-style administration buildings. Since the fascinating hilltop ruins are partially visible from the parking area, the natural impulse is to begin exploration at once. Much better understanding and appreciation of the whole may be had, however, by first touring the splendid museum maintained here by the National Park Service—one of the largest and most complete exhibits to be found in any of our Southwest National Monuments. Here it is possible to learn virtually everything man knows of the story of Tuzigoot.

It is a strange story, one that had its opening about ten centuries ago—possibly a couple of hundred years before the Crusades. Great as this time lapse has been, the green valley surrounding Tuzigoot probably appears little different today from the way it did centuries ago when Tuzigoot was young. Then, of course, there were in the fields neither cattle nor horses, since these animals were unknown in Arizona before the arrival of the Spanish explorers, nearly six centuries after this story opens. Otherwise the scene was about the same. Even

JILT about six and one-half cen-
es ago, Tuzigoot was a village-
lel, strategically situated for defense
fertile haven from drought

➤ THE APEX of the Tuzigoot ruin, showing the doorless rooms which had to be entered by pole ladders through small holes in the ceiling

Nell Murbarger photo

then the valley was checkerboarded with productive fields, for these Indians were peaceful, thrifty farmers who cultivated corn and beans, pumpkins and cotton. From the fruits of their labor they filled their tables and granaries and wove cloth to cover their bodies. To supplement the natural rainfall, they irrigated the fields by means of ingeniously engineered canals and laterals, which carried an assured volume of water from the full-flowing Verde.

For shelter, these First People lived in wattlework huts. They were a framework of closely set poles plastered over with mud, and because they were partially sunken in the ground archaeologists have called them pit houses. The floors were of hard-packed earth. There were no windows, and the whole dwelling was strictly utilitarian, but it sufficed to shed the rain and to turn the not-too-chilly wind. For implements these people worked stone into a variety of forms, and for cooking and storage purposes they made buff-colored pottery vessels. On the whole, life in the City of the Crooked Water was relatively complete without being complex.

But word of a good thing always gets around, and about the year A.D. 1000 these simple farmers began having callers from the north. Like the Man-Who-Came-to-Dinner, these casual visitors remained as permanent settlers. They were Pueblo Indians, and they brought to the Crooked Water a lot of fancy new ideas.

Nell Murbarger photo

⮝ EVEN BEFORE THE STONE VILLAGE was built, Indians living in wattlework huts tilled the valley with the help of irrigation, and it probably looked much as it does today

In the first place, they disapproved of living in valleys. Unlike the Children of the Verde, they had had experience with wars and raiders, and they wanted to be located on the heights, where they might watch for possible enemies. Further, they had progressed architecturally far beyond the primitive wattle huts.

While the hut-dwellers looked on, doubtless in amazement and possibly in derision, these advanced newcomers began the systematic erection of compact stone-masonry houses. They built them on a nearby hilltop, commanding a view for many miles on every side. Tuzigoot's first stone pueblo contained only 15 or 20 rooms, and it probably housed no more than 50 or 75 persons.

Strangely, the pueblo showed little growth during the next 200 years. Apparently things went along smoothly and peaceably enough, but there seems to have been no land rush. Had climatic conditions continued to be normal, it is impossible to say how long this static phase might have prevailed; but farther north in Arizona and southwestern Colorado, a blight had fallen upon the earth.

The year 1276 ushered in a great drought cycle, which continued unabated for 23 years. During that period, practically no moisture fell.

Natural History
CRYPTOMAZE

MINERALS, *By* Edward Dembitz

In this puzzle you are given a set of definitions, each with a set of blank spaces (Part I), and a diagram to be filled in (Part II).

PART I. Each definition is a clue to a word whose letters you are to insert in the blank spaces preceding the definition. These words appear in recent issues of Natural History Magazine.

2 18 6 29	*He explored Alaska and left his name on a sheep, river, mountain, and porpoise*
11 35 37 31 16 42	*A priestess at Delphi who prophesied under the influence of Datura seeds*
12 7 3 15 41	*One member of this feathered family covers its nest in case of danger or absence*
39 13 21 20 27 5	*A basis of fruit jellies and a major component of ramie gums*
34 22 16 4 10	*Glacier-built earth forming much of Corn Belt, once thought brought by bergs*
36 42 26 30 41 22	*He well deserved his name after he led the party that discovered Yosemite*
9 38 24 11 31	*In mythology, a beautiful maiden; in entomology, an immature form*
30 3 17 24 23 40	*Mediterranean insects that were the source of one of the oldest dyestuffs (red)*
33 32 26 40 32	*A tree and wood used for rafts by ancient and modern Peruvians*
4 1 18 28 30 6 27 5	*One flew a famous kite; one searched for a famous passage*
37 18 39 16 19 25 18	*A pudding ingredient familiar to all, made from the poisonous cassava plant*
42 28 25 31 19 14 35	*Hors d'oeuvre for the gourmet, pièce de résistance for the guanay*
36 32 1 34	*"King of the Museum Builders," who taught techniques to many young scientists*
10 8 24 15 29 23 33 8 12	*A beetle, named for its habit of rolling balls of dung*
36 41 18 14 23 7	*A finchlike bird which, working communally, builds world's largest nests*
32 9 20 17 38 21 27 2 13	*A new drug, claimed to cure livestock disease transmitted by tsetse flies*

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The contest is open to everyone except employees of the American Museum and of John Wiley and Sons, and their families.

PART II. When you have filled in all the letters in Part I, transfer them to the proper numbers in the boxes in the diagram below.

1	2	3	4	5	6	7
8	9	▨ 10	11	▨ 12	13	14
15	16	17	▨ 18	19	20	21
22	23	24	▨ 25	26	27	28
29	30	▨ 31	32	▨ 33	34	35
36	37	38	39	40	41	42

When the diagram is completed, the *unshaded* spaces will form a word maze containing at least 25 names of MINERALS. To find one of these minerals, begin with a letter and move from space to adjoining space in any direction, including diagonally, until the name is spelled out. Do not pass through or use letters in shaded spaces while forming names. But it is permissible to pass diagonally between two, as from 17 to 11. Do not form double letters by jumping up and down on the same square. Do not skip squares in the middle of a two-word name.

THREE PRIZES. *The three contestants submitting the largest number of names of minerals fitting this puzzle will each receive a copy of the* Manual of Mineralogy *by Dana and Hurlbut, an outstanding book published by John Wiley and Sons, Inc.*

Names of minerals must appear in bold-faced type in the main A-Z section of Webster's New International Dictionary*—1948 (unabridged) in order to be eligible. Names in bold-faced type below the line at the bottom of the page are allowable. Different names for the same mineral will be accepted. So will variants, alternative spellings, and scientific or technical names, providing they appear in bold-faced type.*

Flagrant disregard of the rules will disqualify a contestant.

In case of ties, duplicate prizes will be awarded.

Entries must be postmarked on or before June 1 and be received by June 6, 1949. You need send only your list of minerals, not the "checkerboard."

Winners and their scores will be published in Natural History *for September, 1949.*

Seeds failed to sprout in the parched fields; or, having sprouted, the starved plants withered and turned brown. Long before harvesting, their burned leaves were rattling crisply in the hot wind. Conditions at last reached the point where entire villages were facing death by starvation.

Perhaps some of these harried people had heard rumors of a remarkable Shangri-La a few days' journey southward—a green and luxuriant valley through which flowed a crooked blue river, where the Rain Gods still sent their life-giving bounty to bless the earth. Or perhaps they had not heard of it. Perhaps they simply started forth desperately and blindly, seeking any port in the storm. In either case, starving refugees from the drought-stricken lands to the north were soon pouring into the Verde.

During that 23-year drought, the population of Tuzigoot doubled and redoubled. And 100 years later, the original hill was all but hidden by buildings, and the influx had spread to surrounding hills, where more than 20 new pueblos had been built.

And then something happened. No one knows exactly what. Possibly enemy invaders succeeded in storming the hilltop villages, although excavation has revealed no evidence of widespread carnage or battle devastation. More likely the tremendous increase in population, with resultant overcrowding and lack of adequate sanitation, eventually resulted in contaminated water with ultimate epidemics and death. Whatever the determining factor may have been, by 1400 or very soon afterward Tuzigoot's great stone pueblo had been abandoned to the winds and to its dead.

Nearly five centuries were to pass before students of archaeology began delving into those ruins, by then all but hidden beneath the accumulated debris of the years. With federal assistance and cooperation of the Phelps-Dodge Corporation (owner of vast copper interests in the vicinity), the pueblo of Tuzigoot was completely excavated in 1934-35. Later, the ruin's 42-acre site, as well as the museum and its superb collection, was donated to Uncle Sam through the interest of local public-spirited citizens, and in 1939 Tuzigoot National Monument was created by presidential proclamation. Since that time, the place has been administered by the National Park Service, with a resident custodian in charge.

That, in brief, is the story of Tuzigoot.

Leaving the museum, a rock-bordered path winds up the hill to the masonry pueblo. It remains largely as it was excavated, only a few rooms having been restored to illustrate the probable manner in which they were finished and equipped.

As southwestern pueblos go, these rooms are singularly large. Several of them are as much as fifteen by twenty feet square, and the average is around twelve by eighteen feet. Compared to Montezuma's Castle, where some of the rooms are but five or six feet square, these must have seemed little short of palatial. Each room, it is believed, was occupied by a single family.

There were no doors in the outer walls. For the sake of safety, entry was gained only by pole ladders extending downward through small apertures in each ceiling. The pueblo was limited mainly to a single story, although eighteen or twenty rooms were originally built with a second story.

On the west slope of the hill is situated a group of rooms that evidently had fallen into disuse while the remainder of the pueblo was still actively occupied. Now, this City of the Crooked Water was not modern either in design or in plumbing. Sewage and trash were simply heaved out through the "front door."

As refuse and debris were cast out by occupants of overlooking apartments, it cascaded down the slope into these abandoned quarters below. In the course of time this residue accumulated to a depth of nearly a dozen feet—four feet above the topmost walls of the old rooms!

Unappetizing as this method of trash-disposal must seem, contemplation of the practice becomes even more abhorrent with the knowledge that this and other refuse piles on the hillside saw double duty as cemeteries. It was the common custom of these people to consign their adult dead to one of the several city dumps. Infant burials were more commonly made within the pueblo itself. Excavations to date have disclosed 170 such interments. Some infants were buried in wall niches, a custom that seems to be peculiar to Tuzigoot.

On the east slope, after refuse had accumulated to a depth of four feet and many burials had been made there, additional rooms were built on top, the already interred corpses being left to rest in peace beneath the floors of the new living rooms.

That this procedure did not denote callousness or indifference toward death is indicated, archaeologists testify, by the splendid burial offerings found with Tuzigoot's dead. Of more than 400 burials excavated here, nearly one-third contained pottery offerings. Many of these pieces were truly magnificent specimens, apparently traded from the north. Jewelry, also, was a common offering to the dead. Some of the finer pieces found here include rare turquoise mosaic, in which the frog motif is of frequent occurrence. One ensemble of turquoise necklace and bangles is said to be the finest of its type ever taken from an American excavation. Other beads and bracelets are of seashell traded from the Pacific Coast and the Gulf of California.

Although these people were wonder-workers in stone, having progressed farther in that art than in any other handicraft, stone weapons and other implements of like nature were not buried with the dead at Tuzigoot, as in the pueblos to the northeast.

The masonry of the city cannot be said to be of a high type if one uses such criteria as the pre-shaping of stone, coursing, and the amount of adobe mortar. However, the stones were selected with care and laid in such manner as to provide a relatively smooth surface, both on the outside and within. Almost without exception the old walls still

Winners of the Seed Plant Cryptomaze in the March issue of NATURAL HISTORY: The three contestants submitting the highest number of seed plants listed in the main section (A-Z) of *Webster's New International Dictionary*—1948 (unabridged), in accordance with the rules of the contest, are: HAROLD EATON, Jackson Heights, N. Y.—189 seed plants; DR. HENRY S. RICH, Bronx, N. Y.—178 seed plants; CATHERINE VAN AKEN, New Haven, Conn.—162 seed plants. Each of these winners has received a copy of *The Wild Flower Guide*, by Edgar T. Wherry, published by Doubleday and Company.

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stand, as true and four-square as though laid with a plumb line.

Scattered along the pathway that leads through the ruins and trodden into the dust underfoot lie countless bits of broken pottery. Their fragmentary designs are still as distinctly clear as when first painted upon the clay, possibly six or eight centuries ago. In many of the rooms are corn-grinding stones, lying just as they were excavated, as well as the smoke-blackened fireplaces over which these long-vanished people prepared their meals.

From the parapeted roof of the pueblo's topmost room, the visitor's eyes travel over the honeycomb of terraced stone walls to the fertile Verde Valley below and on to the coppery desert hills and purple mountains.

Even as ten centuries ago, there still winds through the valley a placid river, smothered in cottonwoods. Spreading away on either side are fruitful fields of corn, beans, and pumpkins. Irrigation canals flow deep and unfailing, watering fields in the valley just as did the ancient canals in the days before William of Normandy set out on his conquest of England.

That Time and the World move on is axiomatic. But here, in Arizona's City of the Crooked Water, the movement has been neither very fast nor very far.

IN CARIBOU LAND

Continued from page 231

tion of that ratio could be expected from time to time, each fluctuation would be followed by a return to more or less normal conditions. The trend of evolution has doubtless been toward perfecting the wolf in its ability to capture the caribou, and at the same time toward perfecting the caribou in its ability to escape the wolf. Unequal progress of this sort on the part of the two species would presumably have been rather disastrous to one or the other. But it is nature's way to have preserved a proper balance between the abilities of the two species, and thus between their populations. This balance (a rather delicate one) has obviously been upset to some extent by the advent of civilized man to the Barren Grounds.

Everyone is agreed that the numbers of the Barren Ground caribou have declined very seriously during the past half century. Herds of a hundred thousand to several millions, such as were reported in the 1890's, are not in the least likely to be seen again. The primitive human races inhabiting the caribou territory are themselves dwindling; neither they nor any natural enemies can be charged with primary responsibility for the deteriorating status of the caribou. For thousands of years Eskimo, Indian, and wolf worked their will on these animals, and they still flourished amazingly. It is civilized man, with his destructive inventions and his inordinate demands upon wildlife, who must shoulder the major burden of responsibility. As a somewhat minor example, the prospectors who have destroyed the food supply of the caribou by burning off large areas in their winter range, merely to facilitate a search for ore-bearing rocks, have been grossly indifferent to the general welfare of both men and animals.

Perhaps the worst threat of all to the caribou has been the introduction of reindeer culture along the arctic coast. This has resulted in interbreeding between the wild caribou and their inferior domesticated relatives. When and if this mixture extends to all the herds of the Barren Grounds, the caribou may be written off the record as a pure species; the animal will have become extinct through dilution, as the biologists express it.

The big movement of August 24 to 28 had represented the peak of the fall migration. For a couple of more days, however, the caribou continued to pass in moderate numbers. On the 30th I returned for another session at Little River and was amply rewarded with camera subjects and notebook material. It was a wonderfully pleasant, balmy day on the Barrens, with a temperature rising close to 70° and bringing out a few black flies and even mosquitoes. There was just a zephyrous breeze, instead of the rude, discomfiting half-gales so prevalent in this well-named area—Windy Lake, Windy River, Windy Bay, and Windy Hills! There was a light blue sky, with a few wisps of clouds drifting lazily along, also a light haze around the horizon, such as I seemed to recollect from faraway boyhood days in New England when the chestnut burs were opening in October. Just before and after the fly season, at the beginning and the end of summer, the Barren Grounds are verily in their finest moods.

September and October came and went, with caribou still about in fair numbers. After the final freeze-up

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on November 1, they were less frequent in the vicinity of camp; but during the second week of the month, Charles found thousands moving southward from the Kazan River area, in herds up to 300 strong. That probably represented their final withdrawal from the Barrens to pass the remainder of the winter in the timbered country south of us.

On December 4, a Norseman aircraft, which had left me pleasantly marooned for nearly three months beyond the appointed time of departure, floated down onto the ice of Windy Bay. Two hours later I was off for Churchill. The Barrens and their caribou were behind me, but their memory will linger on—delightful, indelible, and yet well-nigh unbelievable—to the end of my days.

"Wonder House,"

a Film Portraying the American Museum

The attention of readers is called to a new motion picture entitled "Wonder House," which tells the story of the American Museum of Natural History. It is one of the *This Is America* Series, produced by RKO-Pathé News. Persons interested in seeing this unusual picture should ask the manager of their local theater when it will be shown.

"TREETOPS" *Continued from page 215*

he returned to his splashings and gruntings, either unconscious of us or unwilling to be bothered.

Throughout the night the pool alternated between utter silence and the visits of animals. Unfortunately, a fog came up and partially obscured our view. Often we heard sounds we could not interpret—more splashing, more grunts, and movements in the bush. Sometimes we only knew that heavy bodies were moving in the shadows. The mother rhino and her baby reappeared from time to time, circling down to the water and back through the bush on a regular tour; but as dawn approached, the forest fell still. Then the fog began to lift, and as it thinned we saw the cinnamon-colored bushbuck in the early morning light; and the waterbuck also returned.

We were sleepy at breakfast, for we had been awake all night, but we had enjoyed every moment of the experience and were reluctant to leave for Nyeri when, about ten o'clock, the white hunter and his boys reappeared on the forest trail.

The ladder was lowered, and we made our way to the ground. We examined the rhino spoor and the place where the buffalo had wallowed. We took pictures of Treetops from the ground, and finally we made our way back to where the station wagon was waiting.

In another half hour we were once again looking out across the flower gardens of the Outspan Hotel toward Mt. Kenya, standing so high against the sky. Already we were finding it difficult to believe that Treetops had been real and not imaginary.

▲ AN UNUSUAL PORTRAIT OF A PRAIRIE DOG photographed by Russell W. Walker

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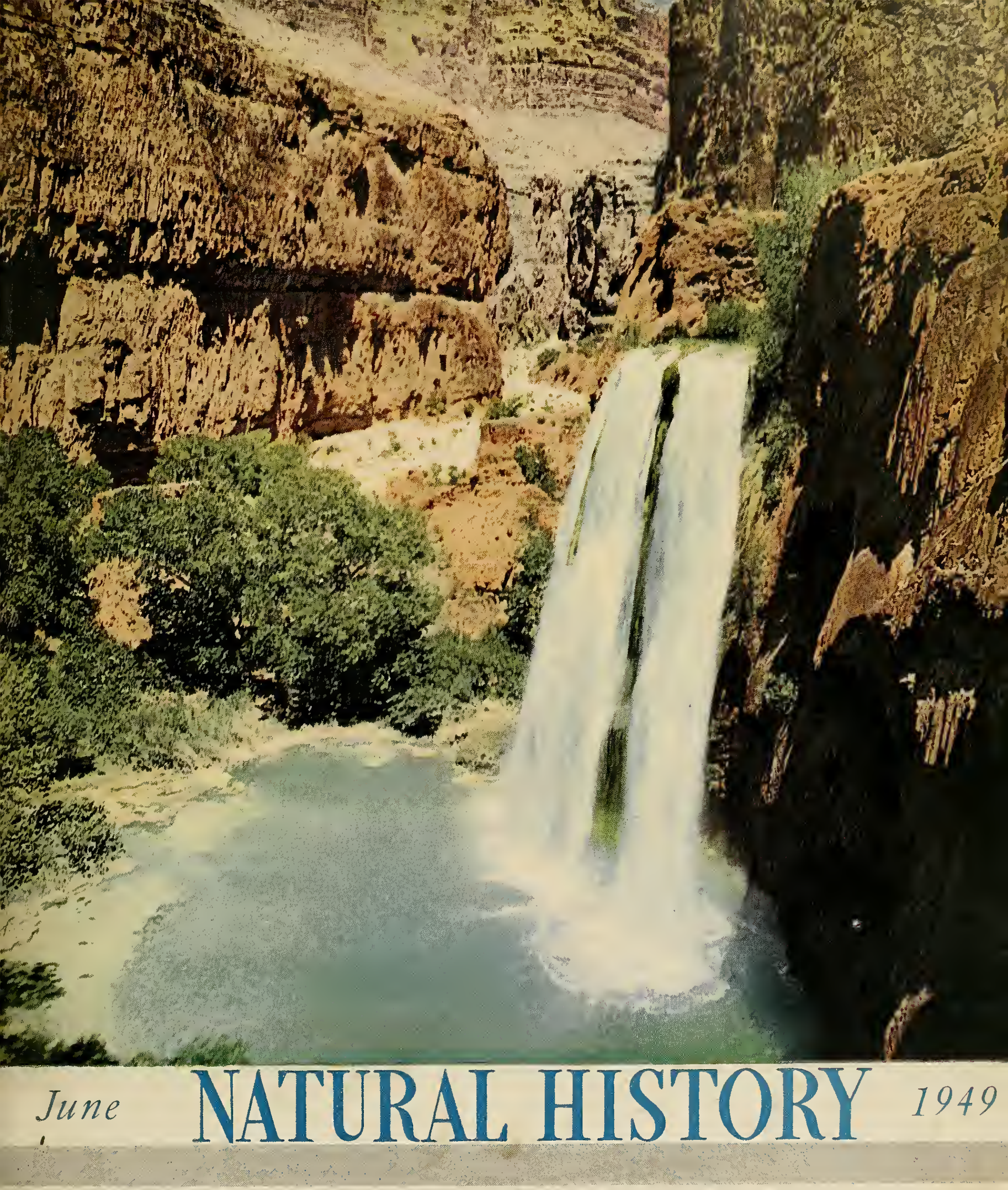

June **NATURAL HISTORY** 1949

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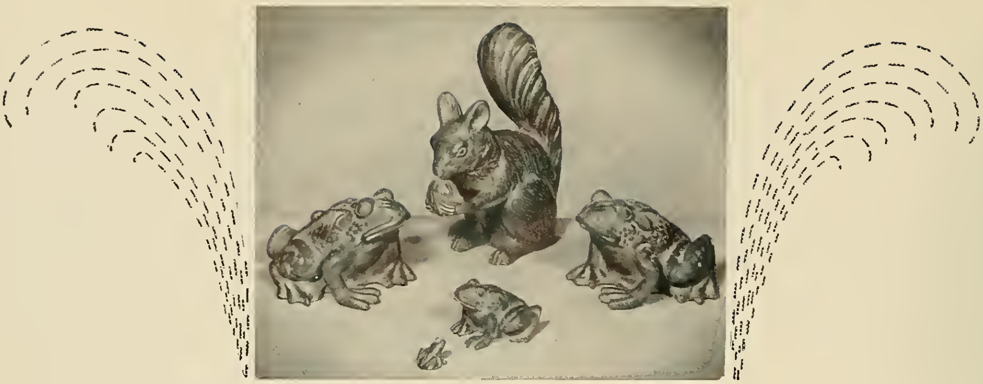

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LETTERS

Molting Mantis

SIRS:

Recently, while making a series of color slides of various insects for use in the San Diego schools, I noticed that one of my models—a praying mantis—was casting its skeleton. As quickly as I could, I set up a camera for black-and-white shots. The result, as you see here, is rather queer.

In the first picture, the fierce-looking mantis appears to be battling another insect while walking on thin air. But give the photograph a quarter turn and you will see what is actually happening. The mantis is just completing a molt. Its skeleton, which it wears outside its body like other insects instead of inside like ours, is hanging by one leg from the twig, with the molting insect suspended below it. All that remains is for the mantis to unsheath the left foreleg. This operation took considerable effort and necessitated the change of position shown in the other photograph.

W. W. WHEATLEY.

Lakeside, Calif.

Wholesale Measures Necessary

SIRS:

Your interesting article on the Praying Mantis in the March issue of NATURAL HISTORY prompts me to inquire how one may introduce these insects into the garden, where you point out they are beneficial.

I tried several years ago to establish them on my 46 x 110 city lot by means of an egg case obtained from a gardener in Ohio. Although we followed instructions, none of the insects ever appeared in our neighborhood. The gardener from whom we obtained the egg case has since discontinued that item. Where can I get some mantises or their eggs?

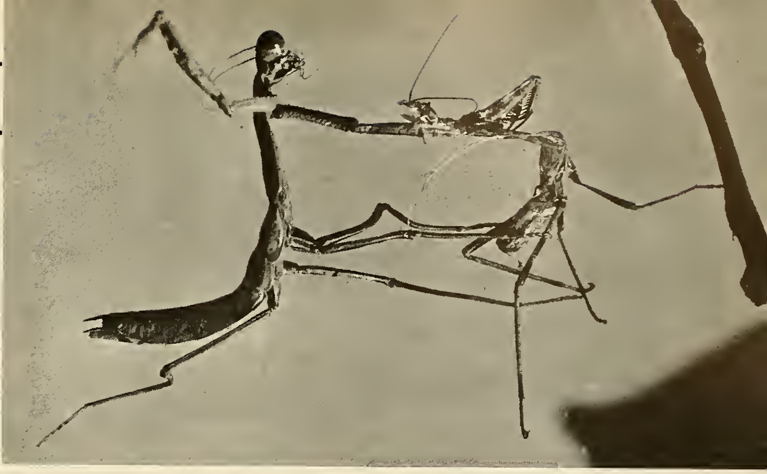
H. J. NOTTAGE.

Portland, Ore.

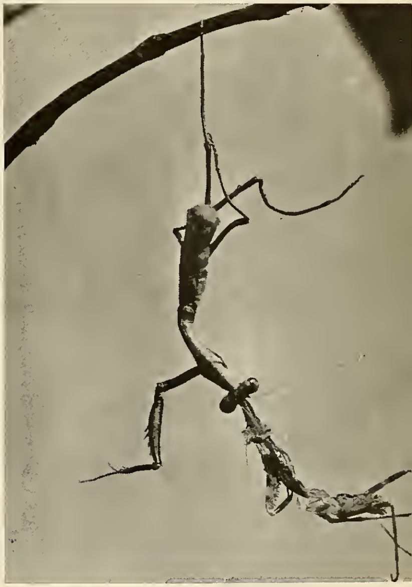
The following advice is offered by Miss Alice Gray, who is "Official Mantis Keeper" in the American Museum's Department of Insects and Spiders:

I assume that the praying mantis you attempted to establish in your garden was the Chinese Mantis, a very large oriental species now common in the eastern United States. Since there are no recorded native mantises in Oregon, it may be that the climate is unsuitable; but the creatures are hardy, and it seems more likely that your experiment failed through not being sufficiently extensive.

I gather that you placed one egg mass in your yard and permitted nature to take its course. If conditions were favorable, about 200 little mantises would have hatched out. Being hungry and active, they would have soon dispersed over a wide area. With average luck, two, or at most three, of them would have reached maturity.



▲ NOT TWO INSECTS FIGHTING but a single praying mantis struggling with "itself." Turn the picture one quarter to the left and you will see that its skeleton is suspended from one leg and is sustaining the weight of the struggling insect. The mantis is almost free



➤ HERE THE POSITIONS have been reversed, and the mantis is doing its utmost to free the one remaining foreleg. Notice the old eye-casing and the skeleton of the antenna. The white "threads" are muscular tissue pulled from inside the old skin

Mantises live only one summer and mate but once. The female devours the male during mating and produces a single mass of eggs. Therefore, even if three of the brood matured, with both sexes represented, and if, with the whole state of Oregon to wander in, they all contrived to meet, only one fertile egg mass could have been produced. This would put you right back where you started. The likelihood of doing even this well is exceedingly remote.

If, on the other hand, you were to introduce a large number of egg masses into a relatively small area, the odd members of the several broods would run a chance of pairing up. The second generation would be much more likely to equal or exceed the first, and the species would be closer to becoming established in the district. If you really want wild mantises in your garden, you will have to use wholesale measures. Secure the co-operation of the neighbors and colonize the entire neighborhood. But first make sure that there is no law against shipping mantises into the state, by asking your State Department of Agriculture. There should not be, since mantises are strictly insectivorous and inoffensive to man and beast.

The egg capsules of mantises are sold by plant nurserymen and by scientific supply houses. Here are a few likely addresses: Butterfly World Supply House, Inc., 289 East 98th St., Brooklyn, N. Y.; Wards Natural Science Establishment, Inc., P. O. Box 24, Beechwood Station, Rochester, N. Y.; General Biological Supply House, Inc., 763 East 69th Place, Chicago 37, Ill. These concerns may keep eggs under refrigeration to prevent hatching. Such retarded eggs would be rather expensive, but the season is too far advanced for you to obtain any other kind this year.

Mantises are reasonably plentiful in the East, but a great many egg masses are needed, and supply house prices are high even in season. Why don't you postpone the experiment until next spring and arrange to have the eggs collected by an enthusiastic amateur? In winter, when the capsules bulk conspicuously on the leafless twigs, scores or hundreds can be found in a single day almost anywhere within the mantis area. This includes Connecticut, New York, New Jersey, and Pennsylvania. If you have no co-operative friends living in this part of the world, you could put a small advertisement in a winter issue of some magazine read by young naturalists. An unrestricted offer of as much as five cents apiece would probably produce an inundation, so you had better invite correspondence before placing your order.

Have the egg masses shipped while the weather is still cold. Distribute them widely over the neighborhood, since overcrowding leads to cannibalism and starvation. Tie the twigs bearing the capsules securely among the branches of shrubbery, with the convex end of each capsule uppermost. Then all you can do is wait. Even if the experiment is succeeding, you may not know it until the leaves fall, revealing the new generation of eggs. A mantis in its natural habitat is virtually invisible.

If the program for naturalizing the mantis in Oregon sounds too ambitious, you might like to rear a few specimens as pets. Secure a single egg mass and place it in a jar with some moist earth or paper to keep the atmosphere damp. When the insects emerge, liberate most of them, keeping no more than you can conveniently tend. For each of these, prepare a separate cage made of a wide-mouthed bottle with an inch of damp soil in the bottom and a piece of cloth over the top. A branching twig should be fitted into each bottle, so that the mantis will have a place to cling while molting.

Water your mantises daily by sprinkling the insides of the cages. More captive mantises die of drought than of any other cause.

In the city, where no wild food is available, I feed young mantises with fruit flies raised for the purpose. Aphids, or plant lice, from the garden would do equally well. So would almost any small insect except ants. Ants eat mantises. As your pets grow larger, they become easier to feed. They will accept earthworms, caterpillars, spiders, and almost any little creature that is not too shelly. They will even take bits of cooked meat offered with a slight swinging motion to simulate life. Although their appetites are enormous, mantises can go for many days without eating, if they have to.

To lovers of mantises as pets it seems unfortunate that their life span is so short. Even if unmated, they die peacefully of old age at about the time of the first heavy frost.

I hope that this answers your query, and wish you the best of luck in your study of a most fascinating insect.

Nature's Deep Freeze

If modern man could step back into the past some fifteen thousand years, more or less, he would find a surprisingly rich and varied mammal fauna in Alaska. He would see not only such mammals as live there today but many others which have disappeared completely from the western world. Mammoths, mastodons, horses, and other mammals which exist today only in the Eastern Hemisphere were just as much North American citizens as the caribou and the moose.

Back in this remote period nature installed a method of refrigeration which has preserved samples of this vanished fauna so efficiently that it is possible today to encounter an occasional animal or part of an animal still in the flesh. Deep deposits of fine silt in the valley of the Yukon have been washed away in hydraulic operations, and these beds are the burial grounds of thousands of Alaska's frozen fauna, usually encountered as bones. From the grass roots down this silt is perpetually frozen, a freeze deep both in space and in time.

On June 13th, a special exhibit in the 77th Street Foyer of the American Museum will show parts of these prehistoric mammals encountered in the flesh in nature's deep freeze. The face and forelimbs of a baby mammoth is the outstanding feature of the exhibit.

The specimens shown are part of the Childs Frick Laboratory collection secured in co-operation with the University of Alaska and the Fairbanks Exploration Company.

Museum Acquires Great Gull Island

An island with a bright future as a wildlife laboratory came into the possession of the American Museum of Natural History on March 31, when the War Assets Administration awarded Great Gull Island to the Museum at a 100 per cent public benefit discount.

Great Gull lies between Plum Island and Little Gull Island some seven miles northeast of Orient Point, the northernmost of the two eastward-projecting "flukes" of Long Island. It is seventeen acres in extent and has served for more than fifty years as an army fort guarding one of the sea approaches to New York City. Prior to 1898, the island was the site of a thriving tern colony estimated at 7000 birds. It was here that the late Frank M. Chapman made his first field expedition for the American Museum in the summer of 1889. Following this visit, and at Dr. Chapman's suggestion, the Linnaean Society and the American Museum arranged for warden protection of the island's sea birds, until the colony was destroyed by the building of Fort Michie.

Great Gull is also notable as the former home of the little-known and now extinct Gull Island mouse. It is ideally situated for ornithological studies, offering fine fishing grounds for sea birds on all sides and being located on a well-known autumn migration route for birds crossing to Long Island from the Rhode Island coast.

Although the Museum will have title to the island, the Linnaean Society of New York has volunteered to plan and carry out research work and assume the costs of administration. A "Gull Island" Committee has been formed to direct operations, with Christopher K. McKeever, well-known Long Island ornithologist, as chairman. Museum members of the committee will be Dr. Robert Cushman Murphy, Chairman of the Bird Department, Dr. Lester Aronson, Chairman of the Department of Animal Behavior, and Richard H. Pough, Curator of Conservation.

Immediate plans for the island center around the effort to establish the common tern as a breeding bird once again, and this summer experiments with decoys will be carried out. Some changes in the island will probably be necessary, such as demolition of certain army structures and the planting of trees and shrubs, but this work will be delayed until the breeding season is ended.

Later work may include banding and other migration studies, bird behavior studies, and possibly efforts to induce other species such as the osprey, petrel, and eider to nest on the island. Population research on small mammals is being considered, and several eastern universities have expressed interest in the island as a site for other natural history studies.

Deserted and desolate now, Great Gull Island seems destined to a busy and useful future as a field laboratory and research station.

Robert S. Arbit, Jr.,
President, Linnaean Society of New York.

End of the World at Hayden Planetarium

During July and August, visitors at the Hayden Planetarium will have opportunity to witness a graphic program on the question of the ultimate fate of the planet Earth. Will the Earth someday freeze when the last atom of energy leaves the Sun? Or may we experience the dread catastrophe of a cosmic collision? These and other questions will be thrillingly discussed.

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NATURAL HISTORY

The Magazine of the American Museum of Natural History

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You will find Natural History Magazine indexed in *Readers' Guide to Periodical Literature* in your library

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YOUR NEW BOOKS

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HIGH JUNGLE • PILCHUCK • BIRDS

ECUADOR AND THE GALÁPAGOS ISLANDS

- by Victor Wolfgang von Hagen

The University of Oklahoma Press, $3.75
290 pp., 17 photos, 3 maps

IN the author's words, this book is an ". . . informal history, told through the personalities of those who have traveled, lived, written, or died within the land of the republic on the Equator." It also contains a liberal sprinkling of natural history and ethnology, all of it related in von Hagen's briskly paced, though occasionally florid, style.

The history is lively and colorful, and the author's knowledge of it is clearly based on extensive research. The reviewer was less satisfied, however, with von Hagen's treatment of the contemporary highland population—particularly the Andean Indians and the cholos, or half-castes. Throughout this section "race" is confounded with "culture" in an alarming manner, and the resulting confusion detracts, inevitably, from his picture of Ecuadorian society. This is doubly unfortunate since von Hagen implies that what he describes for Ecuador is true of the Andean republics generally.

In dealing with the Colorado Indians, and with the head-hunting Jivaro of the Amazonian jungle, von Hagen is on firmer ground, since his knowledge of both tribes is based on first-hand investigation. In describing the fear-ridden head-hunters, the author explodes the myth (if it still needs exploding) that the primitive is a Rousseauist "natural man."

The high point of the book, in the reviewer's opinion, is the section on Ecuador's desolate island outpost, the Galápagos—long a haunt of pirate, whaler, naturalist, and romantic escapist. The history of these "cinder heaps" is traced from their accidental discovery by Spanish explorers to the occupation of the islands by the United States Navy Air Force during World War II. Two chapters are devoted to Charles Darwin; it was his experience with the unique fauna of the Galápagos, von Hagen maintains, that led the great naturalist to propound his theory of evolution.

The book is well illustrated and contains a very useful bibliography.

HARRY TSCHOPIK, JR.

CREAM HILL

- - - - - - - - by Lewis Gannett
with lithographs by Ruth Gannett

The Viking Press, $3.50
191 pp.

ON any highway leading from a large city to the rural countryside you will see them, these people of the week-end world. They travel in cars packed to bursting capacity with their belongings. Representing every class and station in life they come in conveyances ranging from modern super station wagons to rickety old jalopies, but all have one object in view—to reach that shack or cottage in the country in as short a time as possible. The exodus from the city starts in earnest Friday afternoon and increases in volume until Saturday night. The week-end countryman is a modern or new kind of being that is the product of the automobile. He is, as he needs must be in some ways, eccentric. Anyone that will work at a job all week and then spend his rest days at manual labor, pestered by a host of tormenting insects and inconveniences, could hardly be considered exactly normal. The choice location is an old homestead of medium proportions that can be renovated and made livable for week ends. The more dilapidated it appears the greater the appeal to prospective purchasers. During the past ten or fifteen years every available shack within two hundred miles of New York City has been singled out and commandeered by someone. With increasing competition, prices have risen from a few hundred dollars for a twenty-acre tract up into the thousands.

When Lewis Gannett bought a homestead on a Connecticut hilltop twenty-five years ago he got in on the ground floor and was one of the privileged few that had a wide choice in selection. Strangely enough, he found that his great great grandfather had been a settler on this very hill. From his experiences in making the house livable for week ends, linked with personal past history, Mr. Gannett has written this entertaining and useful book that will delight the country-minded. It is a book that the city reader will also enjoy, and the week-ender will find it most helpful in developing the background of his own particular estate. In this interesting narrative is told how year after year Lewis Gannett and his family slowly learned with changing experiences. Eventually they came to intermediate terms with the hilltop, its people's past and present, its plants and trees. As most readers are already aware, Lewis Gannett is a world traveler with broad experience and has traveled all over Europe, visited Russia and the Orient. He now lives in New York when not vacationing at Cream Hill.

GEORGE G. GOODWIN.

HIGH JUNGLE

- - - - - - - - by William Beebe

Duell, Sloan and Pearce, $4.50
379 pp., 49 photos

HIGH JUNGLE is the twenty-second book written by William Beebe. Like the others, it is an account of observations in the field, the mental impressions they invoke, and the philosophical asides in which the author may discourse on a surprisingly wide range of topics. This book is based upon field work in Venezuela, mostly during residence at Rancho Grande, and covers a period including parts of 1945, 1946, and 1948.

As always, William Beebe plans his work well, is accompanied by a competent staff, and brings back masses of material. The area worked in this case is a rich one; Rancho Grande is in a tropical rain forest, a high jungle in the fullest sense of the words. Also the party had ready access to other environments ranging from the waters of the Caribbean to dry and desert conditions. The field of interest was comprehensive, and nothing escaped attention from the highest to the lowest animal or plant. One moment the author may be noting the ubiquitous vulture on high aerial patrol, the next turn-

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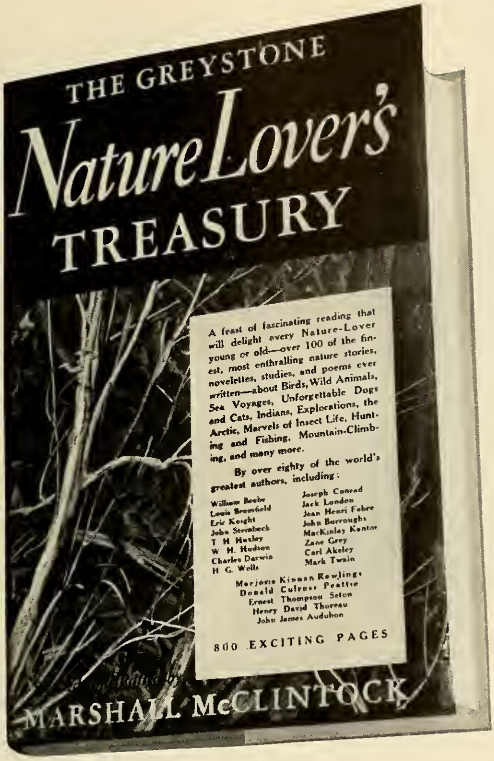

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ing some logs for subterranean encounters.

This inquisitive turn of mind, this readiness to explore even the most trivial (to a casual observer) contact with nature, provides William Beebe with some surprising data. All the aids of modern science are called into play, from high power telescopes to compound microscopes. No creature he meets can, therefore, feel a secure sense of privacy. Like Helen of Troy, he may expect to see his private life exposed in print.

"Although we were one yard away, no slightest doing, no casual or intentional activity was hidden from our prying eyes, no intimacy was foreign to our gossip sheet." From the chapter "Private Lives of Jungle Falcons."

Although some space is devoted to the higher vertebrates and to events that would impress the veriest tyro, of which a landslide is a good example, a great many pages are devoted to lesser creatures, less obvious happenings, and episodes outside the experience of practically every reader. Because of this wide coverage of subject matter, the average reader may find his interest waxing and waning as the topics vary. This reviewer noted that reader appeal, for him at least, was a fluctuating quality.

The book is well illustrated with excellent halftones.

H. E. Anthony.

PILCHUCK: THE LIFE OF A MOUNTAIN

- - - - - - by Harry W. Higman and Earl J. Larrison

Drawings by Edmund J. Sawyer

Superior Publishing Company, Seattle
$3.50, 281 pp.

WELL might we envy a man whose work brings him in intimate association with a mountain for six years. But we who have more prosaic things to do can be grateful that he and his companion have given us a delightful account of the mountain and the abundant life they found on its broad, forested slopes.

One of the authors, Earl J. Larrison, is a young biologist. For his doctorate in the Laboratory of Vertebrate Biology at the University of Michigan he elected to study the ecology of a single mountain from base to summit. He chose Pilchuck Mountain on the western edge of Washington State's Cascade Range, 33 miles northeast of Seattle. There, in an area five by eight miles, Larrison and Harry W. Higman, mountaineer and outdoor enthusiast, ranged from dripping, evergreen "rain forest" at the base to the mile-high, wind-battered crest at timber line—and together they wrote this story.

The authors invent three likable characters, led by "Doc," a biologist, who manage to communicate to the reader the fascination and excitement of discovering the amazingly diverse plant and animal colonies that make a mountain a little world in itself. They found 52 kinds of mammals and over 50 different plant associations, discovered 75 small lakes, and describe in easy, nontechnical language their personal experiences with animals, birds, weather, camping, forests, bogs, cirques, and even ferns, mosses, and lichens.

"Doc" is a much-needed public relations man for biologists. Although slightly didactic, he clearly explains the interrelated life cycles of plants and animals and the importance to man of maintaining some semblance of the original "balance of nature." But Pilchuck, like most of the remnants of our once great wilderness, is a last-ditch stand against the encroachments of civilization. Can the pitifully few "Docs" convince Americans how vital it is to save some of our wilderness heritage in time?

Weldon F. Heald.

THE WAYS OF A MUD DAUBER

- - - - - - by George D. Shafer

Stanford University Press, $2.50
78 pp., 10 plates (4 in color), 10 figs.

MANY an inquiry addressed to the American Museum's Department of Insects and Spiders is: "How can I get rid of them?" This sort of question is asked not only with reference to insects that are destructive or uncleanly but also with regard to bees and wasps that are essentially beneficial. Those more concerned with the possibility of now and then being stung than with the opportunity of making interesting observations may acquire a new viewpoint in reading this book. It was written by a retired professor of physiology who at the age of 75 intrepidly feeds wasps with drops of honey placed on his finger and has enough fellow-feeling for these creatures to go to the trouble of replacing a broken wing in one crippled individual with a whole wing derived from a dead specimen of the same species.

This act of surgery failed of its objective, but the disabled *Sceliphron cementarium* repaid its would-be benefactor by revealing many of the techniques of its specie. It became a "caged animal," supplied by its "keeper" with building material for its cells and with prey in the form of spiders, and it performed under his very eyes.

Observations on structurally perfect specimens of the mud dauber were also undertaken in number—in fact, the study was extended over five years—and the author was enabled to make new and valued contributions to our knowledge, notwithstanding the fact that *Sceliphron* is one

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▲ Dr. Carl Hubbs and Errol Flynn, leaders of the expedition to the nursery of the Gray Whales. The well-known film actor's father is a biologist at the University of Belfast and a friend of Dr. Hubbs

Nursery of the Gray Whales

A thrilling expedition
to Lower California
by air, sea, and land
to locate and study
the breeding grounds
of an animal which
until recently was
thought by scientists
to be close to extinction

By Lewis Wayne Walker

Photographs by the author except where otherwise credited

FEW animals in the history of American wildlife have been lost and found as often as the California Gray Whale in the hundred years since its discovery. Although its weight of 20 tons and length of 50 feet makes this whale plainly visible on a broad expanse of ocean, it has apparently disappeared on three separate occasions.

Postglacial skeletons in Europe, including one that was found when the mud of the Zuyder Zee was being drained, indicate that the Gray Whale was formerly native to the eastern Atlantic. And, if some old whale drawings, presumably American, and vague descriptions of "Scragg" whales can be used as circumstantial evidence, they may once have occurred along our eastern seaboard.

A century ago it was estimated that these marine mammals passed San Diego at a rate of "a thousand a day" in a southward migration that continued practically unabated for a full three months. This abundance was followed by relentless persecution and then by virtual disappearance. It seemed that this shore-loving species was doomed, and even Captain Scammon, a man with the peculiar attributes of a whaler, a great naturalist, and the exploiter of the whales' breeding grounds, forecast their inevitable extermination. Less than a quarter of a century after the publication of his book on marine mammals, the Gray Whales were thought to be extinct along our western coast, and for several decades scientific mention of the species was generally couched in the past tense.

Their next reappearance in the early nineteen hundreds was far to the west and many thousands of miles away. Dr. Roy Chapman Andrews was studying the unknown whales of the orient and in his research, descriptions of some mammals that twice yearly passed along the coast of Korea reminded him of the lost Grays—not only in physical characteristics but also in temperament. These rumored whales were devoid of dorsal fins. They were coastal in habits, and the translation of their Japanese name was "Devil Fish," the identical term used years before by whalers of California and Mexico.

Soon after his arrival at a distant Korean whaling station, village whistles summoned townspeople to the docks, and under the wavering shadows cast by flares, Dr. Andrews saw a tremendous carcass on an incoming boat. It was a California Gray, beyond a doubt; and in the weeks that followed, scores of the dead mammals were brought to port where their carcasses were rendered for their oil and stripped of their edible meat. Many were measured, and a few skeletons were preserved, for it was then surmised that the species might be on the "way out" even on Asiatic shores.

Rediscovery of these lost animals presented peculiar problems of migration and range. Korea was thousands of miles from the whales' established home, and according to previous concepts the Grays were coastal mammals and not denizens of the deeper parts of the Pacific. Had the whales crossed to oriental shores in the recent past, perhaps forced by the incessant pursuit of the American whalers? If so, had they gone directly across the deepest of all oceans or by the long northern route by way of the Aleutians? Or had the species been split for eons into two separate bands—one frequenting the coast of Korea, the other formerly resident along the coasts of California and western Mexico? These questions have never been definitely answered. But again, if we may rely on the sketchy evidence of century-old paintings, credence is given to the two-band theory, for there are some ancient Japanese prints that portray animals having most of the characteristics of Gray Whales.

Until the end of the last war it was believed that Japan had a complete monopoly on "Devil Fish" and that our band had been extirpated from former haunts. But when Dr. Carl Hubbs joined the staff of the Scripps Institution of Oceanography, another chapter on the elusive California Grays began to unfold. A gigantic whale hunt began—a hunt wherein not an animal was killed but which probably called into operation the most imposing array of equipment ever used in the study of a single species of wild creature.

It all started on a small scale when students manned field glasses

▲ **When** the expedition's helicopter was downed by a dead battery, a message for help, spelled out with turtle shells, brought relief. The battery was dropped by improvised parachute

▼ **One of the elusive creatures,** probably a calf, photographed from a hovering helicopter. The Gray Whale reaches a length of 40 to 50 feet and a weight of 20 tons. Ruthless commercial slaughter was thought to have exterminated them in the last century

from lookouts on the Institute roof on the cliffs at La Jolla. From this vantage point they counted the number of whales passing during specific periods of time and charted their routes on shore-line maps. Their findings, published in newspaper articles, aroused the interest of local citizens, and observations from amateur naturalists up and down the coast poured in. After correlating these scattered bits of data, Dr. Hubbs was able to forecast the arrival of a group of whales seen hours before far to the north. In this way, routes of travel and cruising speeds of six or seven miles an hour formed into definite patterns, as an astounding total of 200 whales were counted during daytime hours between December of 1946 and February of 1947.

During this same period there were constant reports of alien submarines in offshore waters, but investigation usually disclosed creatures that blew 20-foot geysers three or four times in rapid succession and then submerged for about seven minutes. As a result, in cooperation with the Navy some attempts were made to tabulate movements with the use of underwater sonar. The government's primary interest was based on identification, while Scripps Institution hoped to determine the numbers that passed nocturnally. This modern phase of investigation unfortunately started after the migration's peak, and so it met with only mediocre success. But the fish and flotsam that registered on the delicate instruments indicated that results might be secured when the passage was at its height.

Additional naval co-operation is scheduled for some future date when an effort will be made to determine the type of communication used by whales. During the La Jolla observations, groups of the cetaceans were often seen to submerge and rise almost simultaneously although separated by at least a quarter of a mile of open water. This occurred too frequently to be mere coincidence, and Dr. Hubbs feels that delicate instruments may make audible some sort of whale signal—perhaps in the supersonic or perhaps in a very low frequency. Porpoises, small cousins of the larger cetaceans, utter a constant series of piglike squeals and grunts when feeding and traveling.

By late January the southward movement had reached its peak, and it was plainly evident that the migration could no longer be looked upon as just a few survivors of an almost extinct animal to be watched, recorded in scientific journals, and then virtually forgotten. Instead, the numbers had taken on such magnitude that the creatures were potentially valuable to both the United States and Mexico. Thus the study abruptly changed from one of purely academic interest to a vitally important research project with an international bearing. Help of the Coast Guard was requested, and this branch of the service cooperated by granting Dr. Hubbs permission to be an observer on a few of their southward mercy flights. Thus in February of 1947, Scammons Lagoon, a famous place in American whaling history, was scanned with powerful glasses from the plastic nose of a P.B.Y. Far below, 101 whales were counted swimming in the winding channels and in the surf at the entrance to the lagoon. Even at that early date some of the cows were accompanied by a single newborn calf.

Photo by G. E. Kirkpatrick

◄ THE EXPEDITION'S temporary camp overlooking San Ignacio Lagoon, the nursery of the Gray Whales

Before this Mexican inlet was found by Scammon, it teemed with breeding whales, calving and nursing their young undisturbed. However, about 1850, Scammon's boat chased some whales into the breaker line on the edge of the desert that forms Sebastian Viscaino Bay. Although the water was shallow and dotted with sand bars that precluded deep dives, the quarry mysteriously disappeared. Search for the animals disclosed a narrow channel running between the breakers paralleling the beach and opening into the whale-choked lagoon, now bearing the Captain's name.

For several years, Scammon successfully kept this valuable location secret, and his boat, the brig "Boston," with its share-paid crew, was the envy of the fleet. It would make a trip around the Horn and return with a load of oil in a few months, a decided contrast to the two- and three-year antarctic journeys made by other New Bedford vessels. According to rumor, however, the secret was divulged in a peculiar way. Another whaling craft sailing north of Cedros Island detected on an offshore breeze the distinctive odor of blubber being rendered. This scent, stronger with every minute of progress, led the strange boat to the breaker line and enabled a lookout in the crow's-nest to see the masts of Scammon's ship over the large white dune that marks the lagoon entrance.

News of this marine treasure spread rapidly, and the next spring found 40 or 50 ships jockeying for the best channel positions and har-

➤ **These unprecedented pictures** of the Gray Whale were taken from the helicopter, here seen hovering over the wake of one of the huge creatures

pooning every passing whale. The slaughter was not only easy but thorough. Floating flag-marked carcasses dotted the placid waters, which soon became red with the uncontrolled butchery. With almost every kill a suckling calf was left to die as an orphan, and within a few years it no longer paid the whalers to venture into the plundered nursery.

A hundred miles beyond Scammons the Coast Guard plane carried Dr. Hubbs over San Ignacio Lagoon. Here a count of 67 whales was recorded, and a few hours later, after an injured fisherman had been taken aboard, 94 were tallied on the return over Scammons. Although this flight was hurried and inconclusive insofar as accurate numbers were concerned, it proved that the whales had returned to haunts vacated long ago. Thus tentative plans for a future expedition, heretofore based on mere theory, were considerably strengthened.

Several of these southern trips were made. Meanwhile, observations continued at La Jolla, where a constant stream of visitors watched the whales as they traveled a narrow, invisible path that took short cuts from point to point. Occasionally the animals were seen to twist about in peculiar gyrations with flukes exposed, leisurely thrashing the water. The significance of this maneuver is unknown. Perhaps it was just a stretching of muscles, tired from the straight, headlong monotony of their swim from the arctic. Perhaps it was a phase of courtship unseen by us because most of their bodies remained a score of feet below the surface. Sometimes one of the tremendous animals would jump completely out of water, landing with a resounding splash. The reason for this action is also unknown but is believed to be caused by the need to take visual bearings or by the irritation resulting from the barnacles that stud their broad backs.

A few individuals of the numbers passing the Institute strayed from their route and ventured near shore, becoming temporarily lost in the maze of kelp. Yet despite the fact that both Oriental and American whalers formerly considered "Devil Fish" the most dangerous of cetaceans, these baffled animals rarely attempted to use their tremendous strength to break a path through the seaweed. Instead, they just swam about the clear areas aimlessly, eventually blundering upon exits leading into deeper water.

During this first spring, the University of California's research yacht, the "E. W. Scripps," was made available for offshore work and was tentatively scheduled for a

➤ **Octopuses** were caught by hand in crevices about 15 feet below the surface. When correctly cooked, they resembled the meat of the abalone

Mexican cruise if financial backing could be procured for the expedition. Here a friendship of long standing between Professor T. Thompson Flynn, biologist of the University of Belfast, North Ireland, his son, Errol Flynn of Hollywood, and Dr. Hubbs prompted the actor to assume the expenses for such an expedition, then set for the following year.

The schedule, planned by Dr. Hubbs and Errol Flynn during the remainder of 1947, worked to perfection in its rendezvous midway between the lagoons. Slow trucks, slightly faster boats, one helicopter with limited range, and five speedy planes were synchronized into an effective unit and reached the distant point according to schedule. The truck camp was established and ready for occupancy at Punta Abreojos lighthouse when the yacht came into sight. At almost the same instant we heard the drone of approaching planes. These had left San Diego three or four hours before, flying over a cactus-strewn territory that had taken us a full week to cover by truck over practically nonexistant roads.

The meal that first night was completely indigenous. Merely what the region provided gave us a truly bountiful repast. Five minutes of barefoot beach scratching had uncovered half a sack of four-inch Pismo clams, while Coyote Lagoon, a small inlet a few miles away, had an abundance of mangrove oysters of two delectable species of bivalve, which we actually picked from the roots of trees.

Mangrove thickets border most of the lagoons in this section of Mexico and are usually established where the plants will be completely out of water at the lowest tides. The roots, however, drop from high tide level like a series of stilts to form an impenetrable leafless jungle, creating the unique oyster beds of the region. In some spots where current and other conditions are ideal, a single root will support several layers of delicious oysters, to be harvested with a machete or ax, instead of with a rake.

Several aspirants to membership in the "Bottom-Scratchers" (an exclusive club of Southern California's expert goggle fishermen) were student seamen aboard the "E. W. Scripps," and they retrieved sea food delicacies from underwater that were not available along the shore lines. Almost every time these swimmers bobbed to the surface they would have large abalones stuck to their chests or would be clutching struggling lobsters or octopuses removed by hand from crevasses ten or twelve feet below. Bert, the cook, watched the larder grow, first with anticipation, then with dismay, as it became higher and richer with each passing minute.

Reconnaisance flights the next morning radiated from the lighthouse and covered both lagoons in an endeavor to select the best spot for the actual whale observations. The broad expanse of Scammons was well populated even though it contained but a fraction of the number of whales that had frequented the spot a century ago. If our planes had been amphibious, this lagoon would have been our choice, but low-flying land planes beyond gliding distance from shore presented dangers we did not care to court. The long and narrow San Ignacio Lagoon was more inviting, and we selected a dry tidal flat on its eastern beach as a temporary campsite for the helicopter. This machine, owned by Paul Mantz, three-time winner of the Cross-Country National Air Races, had been delayed by a weather clause in a movie contract but was due to arrive within a few days. In an endeavor to have the new location ready for work, we made our first mistake.

Mangrove stumps, salicornia, and other vegetation created hazards on the proposed San Ignacio tidal flat runway, and the entire personnel of the expedition was required to make it safe for the heavy cargo planes that were to transport gas, gear, and grub. On our departure from the lighthouse (our prearranged meeting place), a note and map were left for the helicopter crew, describing the location and directing them to a beach a half mile away, where one of us and a cache of gasoline awaited their arrival. By midafternoon the new strip was leveled, and the workers walked to the planes warming up on the desert clearing near by. At approximately the same time, the lookout at the beach gas depot saw the helicopter drop out of the sky, hesitate while the note was read, and depart a moment later in the direction of San Ignacio Lagoon.

Somewhere en route the airborne "windmill" passed the northbound planes, and when it arrived over the new strip, found the spot deserted. Other mud flats of similar nature had been passed on the way, hence both pilot and mechanic concurred in the belief that there might have been a last-minute change of location. Gas was running low, but a faulty generator made it imperative to keep the motor in operation. A 20-mile search for a camp not yet established used the remaining fuel, and a forced landing was made on a lonely point. Then, according to the papers, the helicopter was "Lost in the Wilds of Mexico"!

Seventeen hours later, after a long search, the helicopter was located almost by chance and at a time perilously close to the deadline set for notification of the Coast Guard. One neck of land projecting into the lagoon had been by-passed, and before giving up, Dr. Hubbs suggested a quick look "to be sure we have covered the area." The plane was turned, and soon the grounded helicopter was seen dead ahead. G. E. Kirkpatrick, San Diego Zoo photographer and pilot of the search plane, blew a tire on the landing, and while he cleared a runway for an attempted take-off, Dr. Hubbs gave the famished helicopter crew a lesson on survival. Their only food in over 24 hours had been a light lunch packed in the States, and the last of their water had gone some hours before. After Kirkpatrick's hurried departure to prevent search by the Coast Guard, they remained worried until it was demonstrated by Dr. Hubbs that the oysters and clams were not only edible but very good.

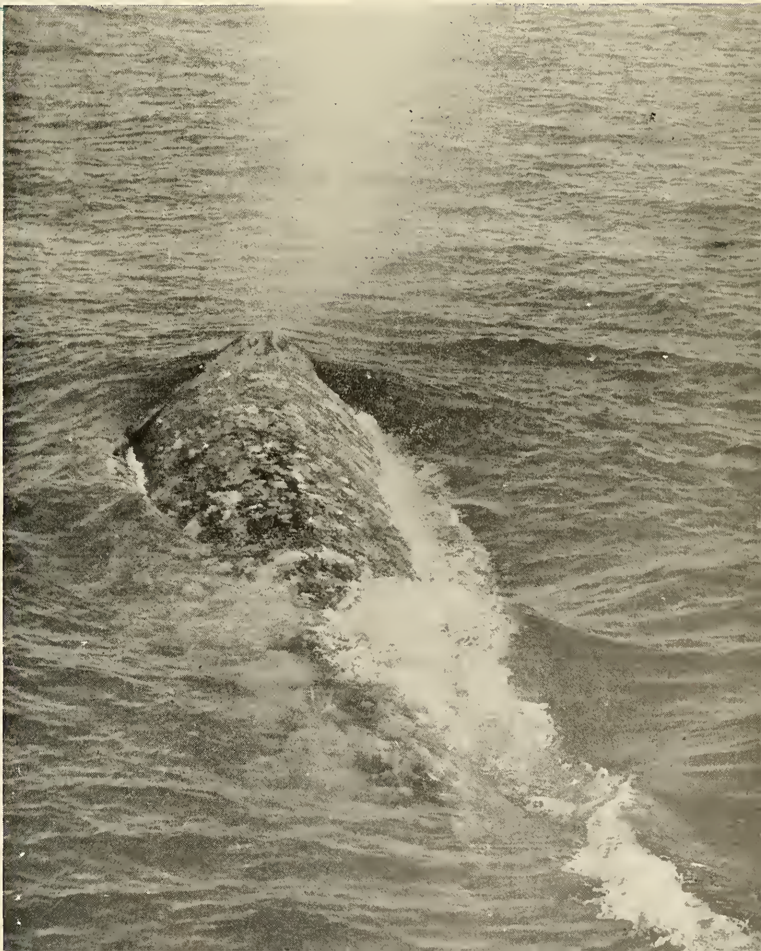
⮝ **A TRIO OF PORPOISES** in perfect formation

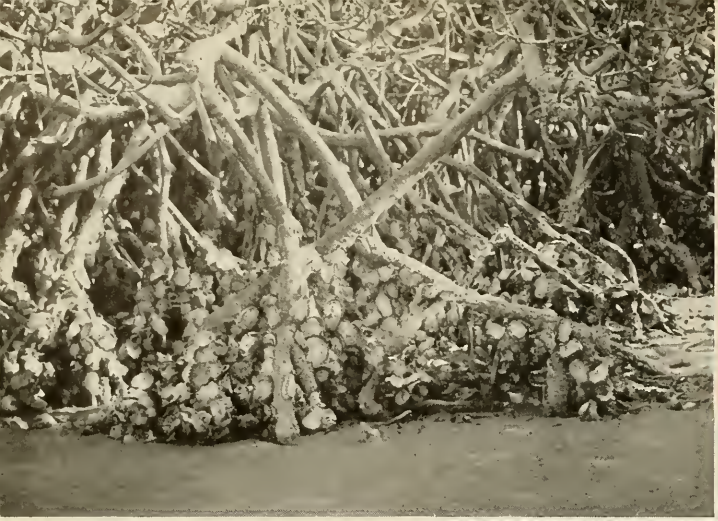
Several hours later a five-gallon can of gasoline padded with a mattress was dropped to the helicopter. This fuel was placed in the tanks, but the weakened battery failed to start the motor. More hours passed. The next time the marooned machine was circled, the crew of the cargo plane saw the words NEED BATTERY spelled out in twelve-foot letters composed of large sea turtle shells gathered from the shore line. The dead battery really complicated rescue plans. The Cub's battery could have been substituted, but this craft was grounded with tire trouble, and the expedition had no other conveyance suitable for a landing on the lonely point. Although doubtful if the battery would stand an aerial delivery, we set to work designing and making an improvised parachute. If this rescue project were to fail, a 1500-mile replacement flight would be necessary, and at least a day's observations would be lost.

When the ten-by-ten tarpaulin was finished, a motley collection of ropes, cords, and hausers hung from the four corners, and its primitive appearance prompted the remark, "Yes sir, the best that brains and bits of junk can build!" The Cub's battery was placed in the center of a cardboard carton that was stuffed with seaweed. This was wrapped in bedrolls and then tied on the underside of the canvas.

Later that afternoon seven of us crouched around the open hatch of the cargo plane as it circled the stricken helicopter. Bill Murray, ex-Army Air Force Colonel, called directions as he banked in for the crucial run. At his command, cargo and canvas were shoved into space. This was our first attempt at spot-bombing, and with the proverbial beginner's luck it almost finished the helicopter. We watched the battery hurtle directly toward the ma-

⮟ **CALIFORNIA GRAY WHALE BLOWING.** A rainbow is sometimes produced in the vapor expelled from the two blowholes. Barnacles are visible on the back





◂ OYSTERS THAT GROW ON TREES. At low tide, thick clusters of the shellfish were exposed on the roots of the mangroves, providing a welcome addition to the expedition's commissary

▾ AT HIGH TIDE, the oysters were underwater, and the mangroves looked like low shrubs

chine we were trying to save. In the five or six seconds of its descent we duplicated, high in the air, the same muscle-straining body-English used by the grounded crew, in an effort to have the heavy cells miss one of the projecting rotors. Fortunately, the helicopter was not hit.

After rendezvousing at the base camp, the remainder of the afternoon was spent on mechanical work, even though whales and their diminutive cousins, the porpoise, could be seen blowing offshore in a tantalizing manner. The drone of planes and the strange sight of the helicopter's return from its forced landing had the effect of primitive tom-toms in calling natives to council. By dusk a score of curious turtle fishermen, the lagoon's only human inhabitants, arrived at our base. Some had walked barefooted many miles over the cactus-strewn desert. Others arrived by burrow, and a few had *pongas,* or rowboats, pulled up on the beach. These fishermen, who eked a living from the waters harboring the whales, were voluble with information gleaned in past years. They pointed out the localities where the greatest concentrations could be expected, and in many other ways were of invaluable assistance.

The first reconnaisance flight consisted of a speedy trip around the shores of the lagoon. At the mouth where the ocean breakers were pounding against barrier sand bars, the channels were dotted with whales. The majority of them seemed large and were not accompanied by calves. In the days of Scammon, most of the animals killed at the entrances to the lagoon were bulls, and according to his theory the males only ventured into the lagoons for quick breeding forays with cows that had just given birth to young.

However, the central channel, which ran far into the desert, seemed to be the main arterial highway, with a steady stream of family groups traversing its blue ribbon of deeper water. Of the scores of whales below, very few were seen swimming up the lagoon, but many were heading in the direction of the Pacific. Subsequent trips disclosed that they more or less followed the tides—up on the incoming, back on the outgoing.

From the vantage point of the hovering helicopter, this tendency of one-way travel emphasized an odd trait that probably would not have been noticed from a surface craft. With but few exceptions, mothers with calves were on the right-hand side of their offspring, and in the next few days we found this to be the usual position when the whales were undisturbed. However, when we hovered ten or fifteen feet above their backs we could drive the calves from side to side, but there were occasions when we saw the mother definitely shield the offspring with her body, slowing her speed if the young lagged behind.

Turtle fishermen became constant visitors, and they talked about the raids of killer whales that sometimes entered the lagoon. According to their observations, a mother Gray Whale would occasionally slip under a calf and place her body

▲ **Green turtles** caught by the Mexican fishermen, who alone frequent this desolate section of the coast

between it and the killer in an endeavor to protect it from these fierce, 20-foot marauders that will successfully attack animals four times their length. They also reported that the mother would sometimes lift her calf partly out of the water with her offside flipper. Aside from these maneuvers, our informants stated that the Grays made no attempt to fight off the orcas but just seemed resigned to their fate.

On the first few flights it was obvious that the nearness of the helicopter disturbed the whales, causing them usually to seek deeper water. However, by hovering behind and to one side, we found it possible to herd the animals in any desired direction, and before long subjects to be photographed were being coaxed into shallow stretches where deep dives were impossible and where muddy trails lingered as sinuous paths against the normal blue of the lagoon. After this had been done a few times, we noticed a decided change in whale temperament. Instead of swimming along in a placid manner, some of the Grays churned the water with flukes and fins until their wakes became swirling cauldrons of foam. Before such displays of angry power, the pilot invariably lifted the craft to a safe 25 or 30 feet. It was easy to visualize the small-boat wreckage of a century ago—crew spewed into the water and at the complete mercy of barnacle-studded tails and flippers of the enraged animals.

From a distance some of the blowing Grays appeared to be almost white, but closer scrutiny disclosed that the effect was caused by a solid layer of barnacles. These shellfish more or less completely covered most of the older animals. Newborn calves, which seemed to be about fifteen feet in length, were a glossy gray-black without the scars and barnacles that marred the skins of their elders. A few of the helicopter observers reported seeing their whiskers—short, bristly hairs that protrude around the mouth area.

On our arrival at San Ignacio Lagoon the Mexican fishermen scoffed at the traits of meanness so often ascribed to the whales in the works of Scammon, and they rowed their *pongas* through groups of whales with impunity. The large beasts usually scattered at their approach. However, after the elusive helicopter had pestered the whales for a full week, they evidently became more like the "Devil Fish" of old. On my last day in the lagoon, cleaning up campsites and paying off debts incurred by the expedition, a boatload of excited natives hurried to the command car and told of the persistent attack by a mother *ballena*. They had been crossing the channel to reset turtle nets and barely gave a second thought to a whale that submerged after a noisy blow. Suddenly, however, they were thrown from their standing positions at the oars, and they saw a giant whale nudging the stern of their *ponga*. The initial strike was the hardest of the attack, and they felt that the boat's combination of flat bottom, extreme buoyancy, and small size was all that prevented a cave-in of the stern. The whale continued to batter and nudge as oars were used on her broad nose to push the craft shoreward. She only desisted when the water became so shallow that her wake was a ribbon of brown mud.

Occasionally some of the whales tarry too long in the shallows and become stranded by lowering tide. Unlike most other cetaceans, however, which die when there is not enough water to cradle their great weight, the Grays are able to survive and take to the water with the next rise in level. Curiosity prompted the turtle fishermen to open and examine one whale that died in the lagoon, and they reported buckets of sardines in the carcass. Until the Flynn-Hubbs study, very little was known about the diet of the Grays at the southern end of their range. Scammon believed they spurned food when about the nursery, but he did report the occasional finding of sea lettuce in their stomachs—a decided contrast to the information that we gleaned from the fishermen.

Comparatively little is known about the breeding cycle of the California Grays. Adults harpooned on their leisurely northward trek from the lagoons contain fetuses that are extremely small, due to recent impregnation, but scanty records of whalers report embryos twelve feet in length taken from cows on the southward migration. This would seem to indicate that each productive cow gives birth every year, although some authorities believe that the breeding cycle is a two-year affair. If this latter assumption is correct, future investigations will probably disclose a band of nonbreeding or resting cows in some other locality. Practically all that we saw in the lagoons were accompanied by newborn offspring, and the few barren individuals were probably two-year olds just reaching full maturity.

The growth of the young is truly phenomenal. Born between twelve and seventeen feet in length, they reach over twenty within a month, when they head for northern waters. The winter following the spring of their birth they return to the south as yearlings, almost full grown but not ready to propagate until another season has passed.

By International Whaling Agreement, protective laws were passed on the Grays in 1936, and all countries enforced them except Japan, in 1937. Killing continued in the orient until 1942, but all countries are now adhering to the international covenant. It thus seems that the future of the Gray Whale is secure and that conservation measures were effected in time. However, even the small concentrations seen from the helicopter represent untold wealth, not to smugglers, as in the days of the illicit fur seal pelts, for 20-ton animals cannot be smuggled conveniently, but as a monetary goad to a sudden repeal of protective laws.

When we consider the tragic history of these whales—in Holland, along our Atlantic coast, off California, and in the orient—it is plain that they are vulnerable, and at present anything short of complete protection would be disastrous. Although their population is now on a rapid upswing, there is still no surplus for harvest. With modern killing devices, a single season of pursuit could force the Grays into their fourth disappearing act—one from which they might not return.

At present, both San Ignacio and Scammons should be set aside as temporary sanctuaries until practical conservation plans are formulated. Some day, perhaps within the next decade, these cetaceans will reach the saturation point, just as the fur seals have done on the Pribilofs. Then the population will level off, and any excess can go toward the needs of man. But protection should certainly be continued until their numbers once more approach the "thousand a day" of less than a hundred years ago.

Insect THERMOMETERS

Know the insect orchestra and you can clock the temperature

By CLEVE HALLENBECK

"I WONDER if it's cool enough for a jacket?" inquired a young woman at an evening lawn party last summer.

"Just a minute," I volunteered, "and I'll give you the temperature."

I gazed at my watch a few seconds, then advised her, "The temperature is 72 degrees. Hardly cool enough for a jacket—or is it?"

She thought I had a tiny thermometer on my watch and wanted to see it. But I had merely timed a tree cricket that was chirping in the near-by shrubbery. I had counted his chirps for 7 seconds, doubled the number, and added 46, which gave me the air temperature.

The crickets are the best known of all insects in respect to their response to temperature and temperature changes. Indeed, one cricket has come to be known as the Temperature Cricket (*Oecanthus niveus*). My interest was attracted to this subject some sixteen years ago when I read a discussion of the work of Dr. Dolbear and Dr. Edes, who had timed crickets against the thermometer. Applying a formula that Dolbear had worked out, I found that the black field cricket (*Gryllus assimilis*) responded well. If you counted the number of chirps it made in 14 seconds and added 40, you had the temperature. With the temperature cricket, you came closer if you added 42, instead of 40, to the number of chirps in 14 seconds. A formula that Dr. Frank E. Lutz gave for this cricket instructs you to count the chirps for 15 seconds and add 40.

The black field cricket is a rather exasperating thermometer, for he does not often chirp for fourteen seconds without a break. For this cricket, it is better to count the number of chirps for seven seconds and double the number. The temperature cricket, however, otherwise known as the Snowy Tree Cricket, is a steady singer and can be heard nearly every night in summer. He is a common cricket, though many mistake his nocturnal chirping for the music of some tiny species of tree frog.

But the best insect thermometer I have ever found is one that, for want of a precise name, I shall have to call Mr. X. It is certainly a species of cricket, but I have never seen one for certain, for it is secretive and shy. It prefers shrubbery and thick-foliaged vines to trees and remains silent and concealed in the daytime. I have never known one to be more than five or six feet above ground. Its chirp is a single syllable, unlike the two-syllabled call of the snowy tree cricket. Dr. H. F. Strohecker informs me that there are only two species of bush crickets in the region of Roswell, New Mexico—*Cycloptilum comprehendens* Hebard and *Hoplosphyrum boreale*. From my description of its call, he thinks Mr. X is the latter.

Photo by Edwin Way Teale

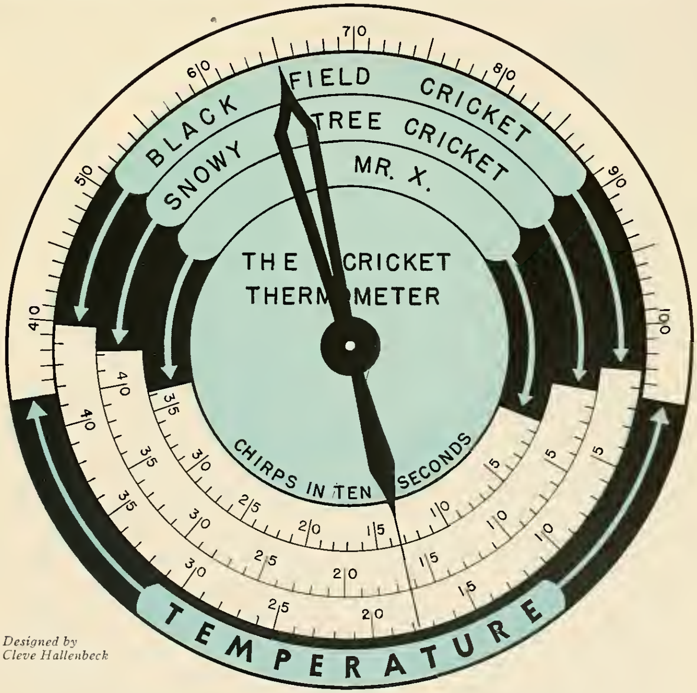
▲ Black field cricket (*Gryllus assimilis*). Count the chirps for 14 seconds and add 40. The sum will be the temperature in degrees Fahrenheit

Whenever I sought this cricket with a flashlight at night, it became mute and hid. The Editor of Natural History urged me to capture Mr. X dead or alive, explaining that, while he could not compete with the "wanted" signs we see in post offices, there would be a modest reward. So, equipped with molasses as bait, I fared forth to capture the elusive Mr. X.

I apprehended a culprit I felt sure was the one I had heard singing, and immediately afterwards, his music ceased. I sent it to be identified by an eastern specialist. Alas, he pronounced the specimen immature and therefore incapable of making sound. We shall in time learn the identity of Mr. X, but until some rather puzzling differences of opinion can be resolved, we shall have to call him by that name. Meanwhile, I can assure you, after careful studies with stop watch and thermograph, that Mr. X will tell you the temperature if you count his chirps for 14 seconds and add 46.

This western cricket merits special attention because it lives in the open and so, like the snowy tree cricket, gives us the free-air temperature. Also, it lasts all summer and chirps through the night—or until the temperature is down to 55 degrees. From about mid-June until frost, its chirp, regular as the ticking of a clock except for a gradual slowing down as the night cools, is heard from dusk to dawn unless the temperature reaches 55 degrees before daylight. In a quiet neighborhood it is audible to a distance of 100 yards. This insect apparently uses the same spot night after night; at least, I frequently have heard what I assumed to be the same ones chirping from the same spots every rainless night throughout the summer. I seldom have heard more than three or four on any one night, and in the daytime I could have pointed out the very spots where, the following night, crickets would take their stands.

I placed a thermograph (a continuously-recording thermometer) within two feet of the nightly posi-



Designed by Cleve Hallenbeck

▲ The cricket thermometer quickly gives you the temperature for three different crickets. With a straight edge, line up the white dot in the center with the number of chirps in ten seconds. The top scale will then give you the temperature

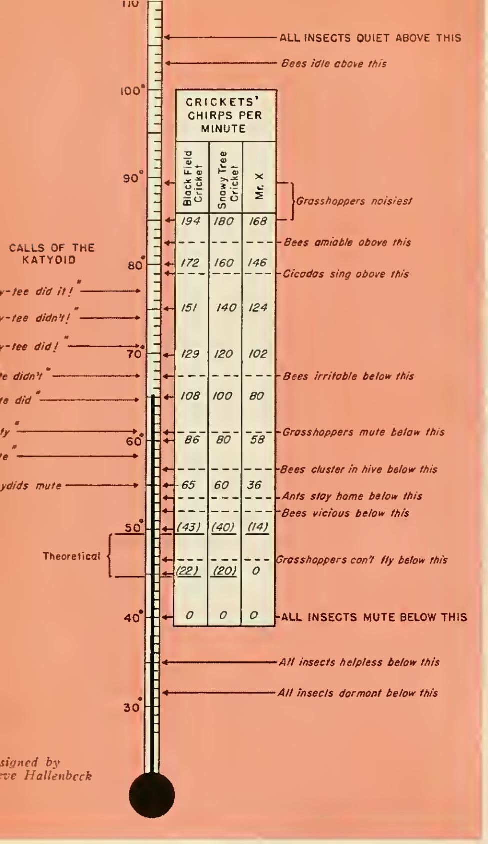


Photo by Lynwood Chace

< A SYNOPSIS of the evening's symphony, showing the rigid schedule followed by the various insect musicians, as well as some incidental activities. How fast they run through the score depends, of course, upon how fast the temperature drops

▲ THE KATYDID sings "Katy-did-it" when the temperature is 77 degrees or higher. At 74 degrees, he loses the accent on the last syllable and sings "Katy-didn't." And so down, until at 55 degrees he becomes mute

tion of one of these crickets near my open bedroom window and counted and recorded its chirps at intervals during the night without leaving my bed. It was a simple matter later to compare the counts with the temperature record. The experiment was repeated at intervals during the summer. A similar method, I may remark, was used in investigating the responses of other insects to temperature changes.

The katydid (*Pterophylla camellifolia*), a green, tree-dwelling cousin of the crickets, is still another insect thermometer. He is confined to the eastern half of our country, and rural folks in that region are familiar with the nocturnal chorus of this insect in early autumn. As long as they last, katydids are tolerably good thermometers, but with scores of them in a single tree and all of them vociferating about Katy's guilt, it may require a stealthy approach and a selective ear to isolate the song of a single one. Few persons, therefore, have probably observed that the katydid's staccato chirps change with the nightly fall of temperature.

He begins singing at dusk, and if the temperature then is 77 degrees or higher, he starts with "Kay-tee did it!" stressing each syllable. By the time the temperature has fallen to 74 he loses the accent on the final syllable and proclaims that "Kay-tee didn't!" With each additional fall of slightly over three degrees, the call becomes, in succession, "Kay-tee did," "Kate didn't," "Kate did," "Didn't," and "Did." (A sharp-eared acquaintance of mine says the last two calls are "Katy" and "Kate.") In northern districts in September—the month of the katydids—the temperature usually is below 75 degrees at dusk, and so the insect begins with "Kay-tee didn't" or "Kaytee did." Incidentally, Katie can say nothing in her own defense, for female katydids are voiceless.

Of course, we must use our imaginations a bit in transforming the katydid's rasping call into words. We may illustrate it by using K for accented and k for unaccented syllables, thus:

Temperature	Katydid's Call
77 or higher......	K–K–K–K
74 to 76.........	K–K–K–k
70 to 73.........	K–K–K
67 to 69.........	K–K–k
64 to 66.........	K–K
61 to 63.........	K–k
58 to 60.........	K
55 to 57.........	k
Below 55........	Katydid mute

The changes in his call do not occur abruptly. The final syllable gradually weakens as the temperature falls, until it ceases or at least becomes inaudible. Then the next syllable similarly weakens and fades out. Also, all the chirps grow weaker and less frequent as the night advances, and the last calls are husky buzzes, apparently produced with an effort. The temperature may be somewhat different in different trees or in different parts of the same tree, and then one can fancy a dispute going on, some katydids affirming and others denying Katie's guilt. When I was a farm boy in Illinois, I believed that the gradual weakening of the wrangle was due to exhaustion. Since during the katydid season the temperature normally falls to about 45 degrees by morning, the katydids become silent long before daylight; sometimes by midnight.

That ground-dwelling relative of the crickets and katydids, the grasshopper, sings only in the daytime and loves the sunshine. Consequently, he is a difficult subject, for the record of a thermograph or thermometer exposed to the sun is utterly worthless. In addition, the grasshopper becomes silent or moves away when approached, and his call, unlike the shrill chirps of the cricket or the staccato call of the katydid, is a buzz of varying length. The length and frequency of the buzz appear to be governed by the temperature, but this insect has baffled my attempt at correlation. However, I have found that he cannot jump until the temperature rises to 39 degrees, is unable to fly until it warms up to 47 degrees, and is mute until the temperature rises to 61 or 62 degrees. From that temperature on up to 85 degrees his buzz becomes louder and more frequently repeated.

Photo by Lynwood Chace

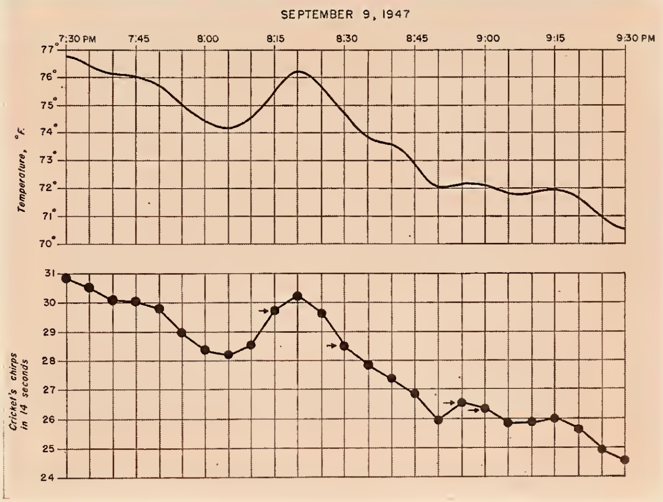
▲ THE GRASSHOPPER sings only in the daytime and is a difficult subject to time against the thermometer. He cannot jump until the thermometer reaches 39 degrees, is unable to fly until it reads 47 degrees, and is mute below 61 or 62 degrees

The three types of insects I have discussed—the cricket, katydid, and grasshopper—all belong to the Orthoptera ("straight-winged" insects) and produce their notes by friction between their outer wings or between these and the thighs of their hind legs. There is another order, the Hymenoptera ("membranous-winged"), including bees, wasps, Diptera, etc., which are voiceless, but they nevertheless show definite reactions to temperature changes.

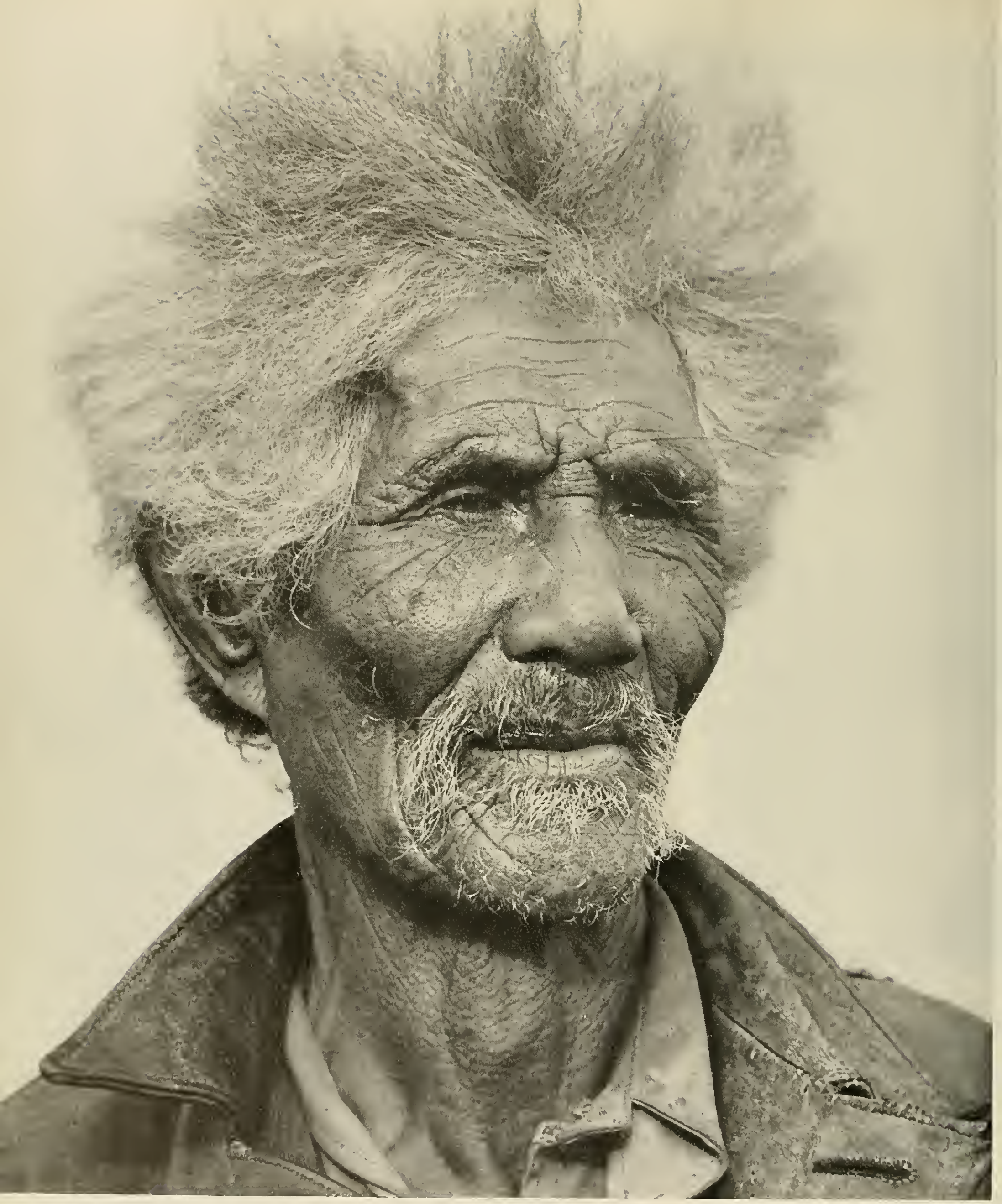
Some of the reactions of the honeybee have been known to beekeepers ever since the invention of portable thermometers. Bees gather into a compact cluster within the hive when the temperature falls to 57 degrees and do not "break cluster" as long as the temperature remains below that figure, although they still are able to fly at 40 degrees. As the temperature sinks below 57, the clustered bees begin buzzing to generate heat and thus are able to survive the winter. Honeybees are almost vicious at temperatures in the lower 50's and are still cross in the upper 60's. However, as the air warms up, their disposition improves, and from 85 degrees on up they are almost amiable. (But there are other factors that influence their disposition. They are gentlest when busiest, other factors being equal.) Beekeepers avoid disturbing their bees in cool weather or right after a rain, but on a warm summer day a busy hive can be dismantled and its comb frames scattered about without arousing the wrath of a single bee, provided it is done gently. Bees are inclined to loaf at temperatures above 103 and work best under outdoor temperatures in the 80's, but they maintain 98 to 100 degrees in their hives when building honeycomb, at least at the place where they are building.

The common housefly seeks warmth at temperatures below 55, which means that with the thermometer at or below that figure the fly would rather enter your house

Continued on page 285



➤ TEMPERATURE ACCURACY of cricket. The four arrows show the only places where the insect did not agree with the telethermoscope, and in no case was the difference more than one-quarter degree. It is possible that the instrument did not respond as quickly to a change as the cricket did



▲ HURUMA NUTIRA'S AGE is unknown, but estimated on events he can remember, it would be between 95 and 100. His eyesight is exceptionally good, and he still delights in taking an active part in the catching and preserving of eels during their yearly migration

Eeling in New

Zealand

An ancient native art is still practiced today in the land of the Maoris

By WILLIAM J. GREEN

EVERY year millions of eels migrate to the sea from New Zealand's rivers, and it is then that the Maoris take their harvest of eel food. They set their traps (*hinakis*) in the rivers or use other methods customary in their locality to gather the slippery, squirming mass of eels that help to keep hunger away during the winter months. Somewhat confusing to the outsider is the fact that the word "tuna" means eel in that far southern land.

For centuries the Maoris have been taking tons of eels annually from every stream and lake in the country, but the eel population never appears to lessen. Even today, when the *Pakeha* (Paleface) is fishing the streams every day for eels and dispatching them to Britain and Europe to assist the food supply there, the number of eels does not yet seem to have decreased.

But there are many places in New Zealand where the *Pakeha* may not fish. These are the ancestral fishing grounds of the Maoris. One such spot is at the outlet to the sea from Lake Forsyth in Canterbury, South Island of New Zealand. Here eels have been caught for centuries by several Maori families, the method having been handed down through scores of generations. Today the descendants of those ancient eel-trappers still catch the eels in the old-fashioned way, preparing them for trading as their ancestors did and making a good living from their catch wherever there are Maoris willing to buy.

Scientists have discovered that the eel is a source of valuable oil, a poultry food, and a fertilizer, as well as one of the richest vitamin-packed foods in the world. From 5000 tons of eels can be extracted oil worth $100,000, plus 2000 tons of fertilizer worth $30,000. The oil, which is in demand as a diluent for the fish-oil industry, is very rich in vitamins. The older and bigger the eels, the more vitamin A and D they contain; and the oil content is so great that they require no fat when being fried.

Since his coming to New Zealand from Polynesia, the Maori has learned to value the eel as perhaps his greatest delicacy. To ensure that the trapping never failed, he studied the eel and learned everything he could about its habits. Always he is ready when the annual migration begins, for the eels are in their best condition when they start their journey. When the vast swarms of eels leave their homes in the lakes and upland waters and head for their breeding grounds in the sea, the traps are in position and the harvest begins.

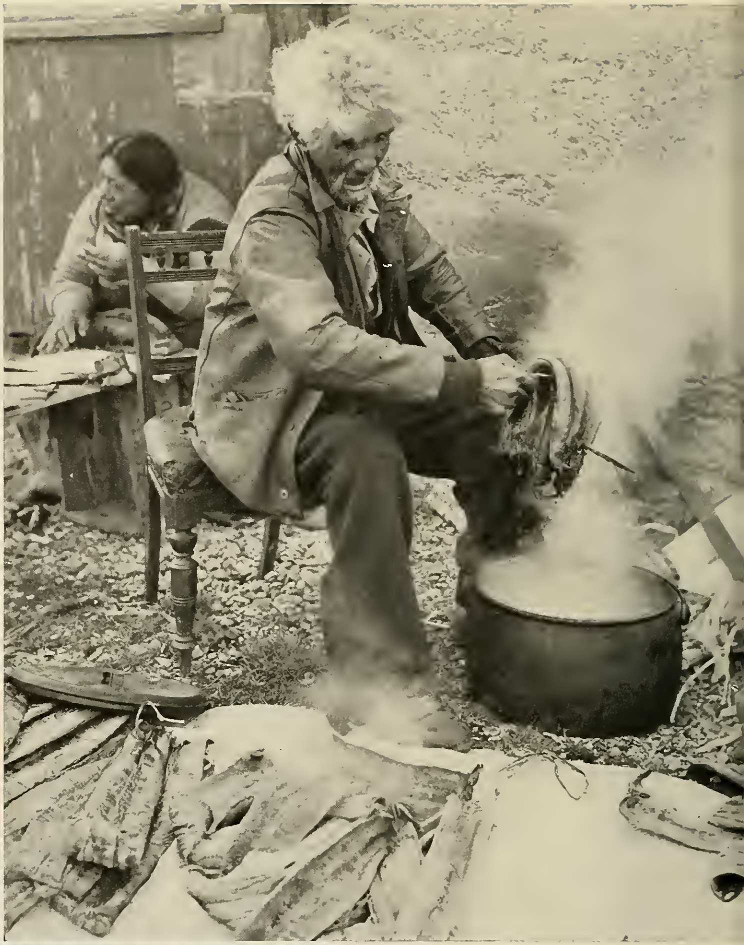
In North Island rivers, the method of catching eels during their annual migration to the sea is by means of eel weirs (*pa tuna*). These are composed of wooden fences with uprights set closely together to prevent the eels from passing through. The fences are arranged in V-shape, with the open apex downstream, or in two parallel rows slanting across the current. The traps, termed *hinaki*, are usually made of vines, with a funnel entrance, and are set at the lower ends of the weirs.

At Lake Forsyth, in the South

▲ MR. WHARERAU WHAITIRI demonstrates the method of catching eels during migration, while Mr. H. Nutira watches with a knowing eye

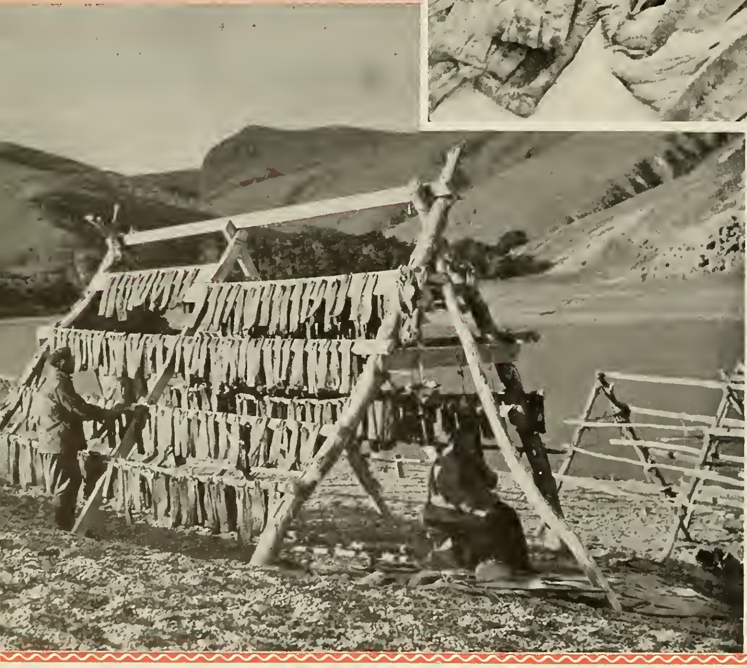
Island, a much simpler method is used. The lake is separated from the sea by a shingle bank, and a channel is cut into the shingle at its lowest point, nearest the sea. The channel is approximately fifteen yards long by one yard wide, and into it the eels squirm so quickly and thickly that they are readily pulled out with a modern gaff. The side of the artificial channel has been used for generations, and only the local Maoris who have ancestral rights may use it.

Only the legendary Tuna Tuora remain behind when the eel migration starts. They are the giants—actually permanently sterile females. This explains the individual weights of 40, 70, 80, 96, and even 130 pounds that have been taken in some of the great inland lakes. These giant eels, according to Maori folklore, come barking out of the river at night, looking for lonely men to devour.



▲ AFTER THE FIRST DRYING, the eels are boiled for ten minutes. This renders them more pliable for eating. They are then hung up for a final quick drying before being packed and forwarded to other Maoris in New Zealand. This picture shows Mr. Nutira removing the cooked eels from the pot, while his wife bones them in the background

▼ A VIEW of the *whata,* or drying structure, laden with eels drying on the banks of Lake Forsyth



➤ WHILE THE MEN attend
the drying of the eels, th
women are kept busy makin
flax baskets, in which the ee
will be transported when final
cured

To protect themselves against this menace, the ancients used to light fires and scatter the hot ashes in the belief that Tuna Tuora could not cross such a barrier in search of victims.

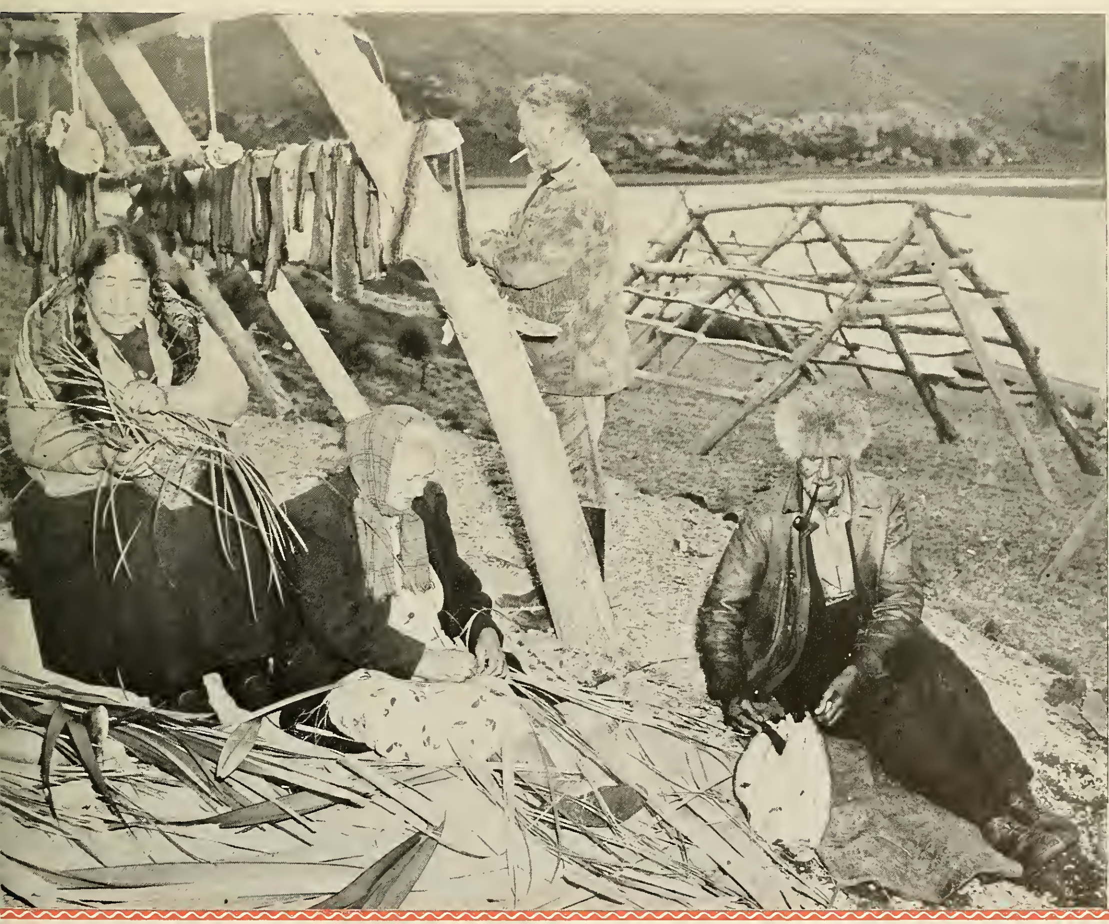
Preparation of the eels is a task shared by men and women alike. The eels are split lengthwise, and the intestines and whole backbone are removed. The liver, which has a very high oil content, is always removed and eaten as a special delicacy. At this stage the eels are called "green," and they are hung out on *whatas* to dry. The skin is not removed from the fish, because it too is valued for its food properties. The *whata* is usually built like an inverted "V" and runs north and south to take advantage of the prevailing northeast and northwest winds. At night the eels are removed indoors. The wind is the drying agent. If the sun is shining, they have to be protected with matting.

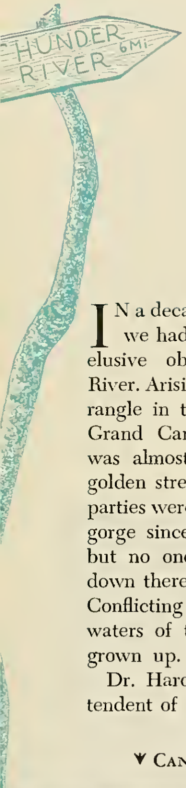
Preliminary drying takes four or five weeks. After this the eels are boiled for ten minutes and then returned to the *whatas* for several days of further drying. When this process is completed, they resemble hard strips of leather, but they can then be eaten just as they are, or they can be boiled or braised.

It is in this dry form that they are sold or exchanged for muttonbirds with other Maoris of the far south, or for cod with the natives of the Chatham Islands. Any surplus from the catch during the brief period of migration is carefully stored to ensure supplies during the winter months, when the trapping is never very good.

Fresh eel tastes rather like trout, and for the white man the favorite method of cooking is stewing. First the flesh is plunged into boiling water for a few minutes to rid it of some of the oil. The fish is then dredged in flour, pepper, and salt and placed in boiling stock into which an onion stuffed with cloves has been added, plus some mace and lemon juice.

After gentle simmering for half an hour, the fish is removed and the gravy is strained and thickened. The fish is returned for thorough heating before serving, and sometimes a little port wine is added. Stewed New Zealand eel is a treat for those with discriminating palates.





Thundering Waters

A descent into the little-known northwestern section of the Grand Canyon to settle conflicting rumors about a spectacular waterfall

By PHILIP FERRY

Photographs by ALFRED SCHMITZ

IN a decade of desert exploration, we had never aimed at a more elusive objective than Thunder River. Arising in an unknown quadrangle in the northwest corner of Grand Canyon National Park, it was almost as lengendary as the golden stream of Pactolus. Several parties were said to have visited the gorge since its discovery in 1904, but no one had apparently been down there for a number of years. Conflicting tales of the thundering waters of this fabulous river had grown up.

Dr. Harold C. Bryant, Superintendent of Grand Canyon National Park, first proposed the expedition to my friend Al Schmitz and me, after briefing us on the strange story of Thunder River. From time to time over the years, he had received exciting reports of magnificent waterfalls in the canyon, always sighted from a distance by a park ranger, a wandering cattleman, or some local explorer. Some reported mile-long cataracts foaming like Niagara and tumbling down the canyon with a roar like thunder. Even persons who had never seen the river declared that from points on the North Rim they had heard the thunder of its falls and cataracts. None of these accounts were ever substantiated in full by other narrators; no two agreed on even the broadest aspects. But they concurred on one point: the sight was stupendous.

The most violent disagreements concerned the origin of the river, its size, and the length of its falls. Local tradition had it that the river issued full-born from a tremendous fissure in the canyon wall to go charging down the canyon like a stampede of wild horses, plunging over great drops and rushing along with mad fury. Hade Church, commercial packer and guide, esti-

▼ CANYON OF THE COLORADO RIVER from the North Rim, with Thunder River out of camera range at left

THE TWO LONG DROPS of Thunder Spring Fall

➤ THE WILD WATER of Thunder River

mated the falls to be 500 feet, while Jonreed Lauritzen, who in 1941 published an account of his visit, denied that any falls existed. Further, he contended that the river had a most uneventful birth, issuing mildly from a spring at the base of a cliff and never, throughout its 8-mile course to the Colorado, exceeding 75 feet in width. This description was so at variance with other reports that Lauritzen could account for the discrepancy only on the ground that the water volume must vary with the seasons. Yet all the conflicting reports suggested that few of the narrators had ever been close enough to the river to estimate its true character with any degree of accuracy.

It was months before Schmitz and I decided to hazard such an expedition, but the bewitching fables of Thunder River were irresistibly intriguing, and the difficulties presented by such an undertaking were a challenge not easily dismissed. So we engaged the services of Billy and Tuffy Swapp, local cowpunchers, whose familiarity with Thunder Canyon made them valuable guides. The trip was scheduled for April, in the hope of getting into the canyon when the water was at its fullest, to confirm or disprove the tales about the falls.

Early on an April morning, 1948, we loaded our gear into a jeep, and Tuffy drove us nine miles through a driving snowstorm to the take-off point near Little Saddle, located at the very brink of the chasm. Here he left us, and Billy took over.

We walked our horses to the edge of the great chasm and looked several thousand feet down into a tortured land of red and buff canyons. Pointing toward the east, beyond a great fin of red sandstone that stood in lone solitude above the canyon floor, Billy said, "Thunder River flows through a smaller canyon that is three levels below this point. I doubt if you can recog-

nize it from this distance. It's twelve or fifteen miles from here."

We studied the depths of the canyon with some misgivings.

"I don't understand," Billy continued, "why anybody wants to go into that gloomy hole! Even the animals dislike the place. We always get out as quick as possible."

We looked at Billy apprehensively but mounted our horses, and he led us down a precipitous trail that fell away into the canyons.

There were five of us poised for the attempt on Thunder Canyon. The gear each carried included sleeping bag, poncho, camera, extra shoes, personal items, and emergency equipment. We had climbing ropes to help us up and down the canyon walls. And since we hoped to put on record for the first time all the pertinent data on Thunder River and its canyon, we were equipped to compute the height of the canyon walls, the width of the river, and the velocity of the water. We even had a thermometer to take the water's temperature!

Without a guide it would have been virtually impossible for us to locate the beginning of the trail. Once Billy pointed it out, it was plain enough, but we could see that down on the flat it petered out completely and Billy would have to rely entirely on his knowledge of the country.

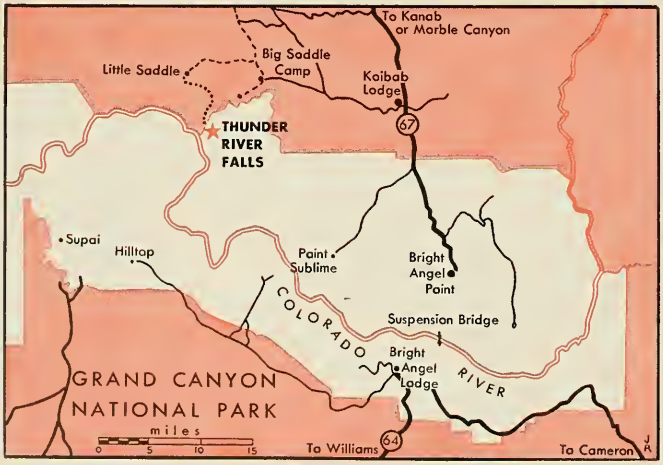
Taking off from Little Saddle, the trail dropped abruptly in a series of switchbacks that plunged down the face of the cliff through the familiar Kaibab and Coconino formations. However much it wandered about, it always managed to return to a steady course eastward. Nearing the interesting geological formation called the Fishtail, it leveled off on a bench of the Supai formation. Continuing eastward, we made our way over the henna-colored sandstone for six or seven miles. Billy was careful to point out the occasional pools of water trapped in sinkholes in the sandstone, knowing how necessary the water would be to the animals on the uptrail back—knowing, too, how vital it would be to anyone who might become separated from the party.

At one confusing spot, it was necessary to make an abrupt right-angle turn to skirt a chasm that blocked our path. Billy dismounted and whittled out a wooden arrow, then scratched in the words "Thunder River, 6 mi." and set it upright in a cairn of boulders. For the first time the trail to Thunder River had a trail-marker.

Threading in and out of a maze of canyons that would have baffled a mountain sheep, we eventually found ourselves at the top of the Red Wall, an infallible geological signpost in the Grand Canyon country. The trail down the wall was so steep that we dismounted and made the descent on foot, taking care to avoid the hooves of the skidding animals.

Dropping down to the second of our three benches, we found ourselves at the head of Surprise Valley, a saucer-shaped depression with olive-hued desert vegetation. Continuing eastward, we made our way across the valley and up the farther slope of the saucer. Reaching the rock-rimmed lip, we peered over into a wild canyon that opened at our feet, and got our first glimpse of Thunder Spring and Falls. A final drop of 1000 feet and we stood at last in full view of our objective.

This route approached the spring from the topside and paralleled the creek for its entire length. The trail ran so close to the creek that at times the water actually flooded the trail. This approach gave us a full-faced close-up of Thunder Spring from the time it issued from the canyon wall to its confluence with Tapeats Creek, a few hundred feet away. We set up camp at the foot of the tumbling creek, and its rush-



THUNDER
RIVER 6 MI

▲ The party erected a trail marker, the first to show the way toward Thunder River

➤ Camp near Tapeats Creek, wh
rushing waters lulled the party
sleep each night

ing waters lulled us to sleep each night.

Looking at the magnificent spectacle, we had to admit that the men who told the tallest tales had been most nearly correct in their descriptions. Thunder Spring does indeed issue from the canyon wall, and it does (at least at the season when we saw it) form a magnificent waterfall in its long drop to the canyon floor. The fall is remarkable in that it is not formed by a stream tumbling over the canyon rim. It originates in a subterranean source and pours directly out of the cliff wall, about midway between canyon bottom and rim top.

At the time of our visit, the water issued in twin streams from two vertical slits in the cliff wall, perhaps 1000 feet above the canyon floor. The two streams fell 50 feet in a V-shaped pattern and then merged to form the first waterfall. From this point, the fall has a form similar to that of Yosemite Falls, in California, for it drops 100 feet in a straight fall, then glissades a few yards over a rocky shelf, to drop away again for 150 feet. Finally it glides down the canyon in a long cascade that runs a short distance to a juncture with Tapeats Creek.

▲ TAPEATS CANYON, with Tapeats Creek in foreground

While Hade Church's stupendous yarn about a 500-foot waterfall would seem a considerable exaggeration, his estimate was a matter of individual interpretation. Taking the fall from the point where it issues from the canyon wall to the spot where it levels off into a rushing cascade, the over-all drop could be close to 400 feet. As explained, however, the plunge is broken into three distinct drops. Viewed from the rim top, where most of the witnesses stood, the moving white sheet would undoubtedly tend to flatten out into an unbroken plane and thus create the illusion of an uninterrupted plunge.

At its widest point, just at the first drop, the fall is perhaps 100 feet wide. Its plunge is not a smooth one but is interrupted by a rocky background that causes it to ripple gracefully down the cliff face. The full career of the stream—Thunder Creek, as it is called at this point—is not more than 1000 feet. Tumbling and roaring down the narrow canyon, it runs at a right angle toward Tapeats Creek. At its juncture with the creek, it separates like the tines of a trident and enters the larger stream in three distinct arms. All in all, it is a magnificent spectacle.

Thunder River is well named, although no one knows who named it. In 1869, Major Powell, the original explorer of the Colorado River, saw only the confluence of the lower river with the Colorado and named it Tapeats Creek after a Paiute Indian in his employ. On some maps it is so identified; others call *this* stream Thunder River, much to the confusion of map makers and explorers. With a roar it rushes along at a rate we estimated to be 20 miles per hour, a speed normally reached only by floodwater racing down a narrow gorge. Always it is a charging demon rushing headlong to a union with the Colorado.

The bursting of water out of the cliff walls appears to be a characteristic feature of the region. At frequent intervals throughout the canyons, openings in the sheer walls give evidence that water may have issued from them at some time in the recent past. Indeed, flanking Thunder Spring itself are several cracks in the cliff walls from which water gushes in graceful falls that are miniatures of the main fall. It may be that a large subterranean stream flows through the district, breaking through the cliff walls at various points, changing its course over the years, and forming the frequent minor chasms that characterize the region.

Thunder Creek may not be unique, therefore, in issuing from a vertical wall, but its impressive birth 1000 feet above the canyon floor, its width and plunge, and its short, explosive run to a junction with Tapeats Creek are impressive beyond words.

On our last day in the canyon, Thunder River gave us a near-tragic demonstration of its velocity and ferocity. On our way out of the canyon, as Schmitz was delicately guiding his horse through the foaming rapids formed by the joining of Thunder River and Tapeats Creek, the nervous animal lost its footing and plunged sideways into the stream, landing full on the rider. Bobbing to the surface, Schmitz managed to shake loose from the stirrups. With his heavy photographic equipment strapped to his back, he was caught up by the racing rapids and projected downstream, head foremost and backward, helpless to save himself and unable to see where he was heading. He hurtled along too fast for us on shore to aid him and finally was brought up against the bank 100 feet downstream, where he managed to struggle ashore. His back was painfully bruised, and some of his valuable photographic equipment was lost.

Every Kodachrome he had taken in Thunder Canyon was ruined. After two years of planning and preparation, culminating in days of photographing, the film that was to be a major reward of his visit to Thunder River had suddenly become a water-soaked loss. Although the other photographers in the party had been busy taking pictures, Schmitz, who had been most instrumental in projecting the expedition, emerged without a single color picture of his own.

With the aid and counsel of Billy the packer, who has run cattle into the region since boyhood, we were able to solve much of the mystery surrounding Thunder River. The confusion is caused by a duplication of names and by the fact that not one but two streams are involved. When Lauritzen speaks of Thunder River as issuing "mildly from the ground," he is correct in describing one stream. When Hade Church and Ranger R. E. Laws, of the National Park Service, contradict him by declaring that Thunder Creek pours spectacularly out of the cliffside, they, too, are correct. However, the two factions are describing different streams. That R. E. Laws was referring to Thunder River and not Tapeats Creek became dramatically evident when we found his signature scratched into a large sandstone boulder at the head of the steep trail leading down to the stream. The date accompanying the name was Feb. 15, 1924.

Further confusion is added by the fact that Tapeats Creek rises in what local cattlemen call Bridger Canyon—and there are two Bridger Canyons! Tapeats Creek is designated by the U. S. Geographic Board as the main stream, which arises on the North Rim of the Grand Canyon and flows southwest to the Colorado. Thunder Creek or River drains southeastward into Tapeats Creek.

While we had planned to explore upstream in Tapeats Creek the great volume of water, together with the rocky nature of the stream bottom, rendered such a venture too precarious to undertake. While Tapeats Creek is not deep (except in spots where there are pools 20 feet deep), it is exceedingly swift. We were able to ford it only by horse and then at carefully selected spots. Billy assured us that during previous visits he had found the water at the ford only knee-high; this time it reached his hips. Generally the water is crystal-clear, but at this time of high water it was muddy and opaque.

While travel upstream was not practicable, there were no appreciable obstacles to our progress downstream to the Colorado River, and we made the round trip several times during our stay. This is rugged country. The canyons are narrow and rough and give evidence of having seen convulsive action in the past. Tumbling cliffs, prodigious boulders, and sinking terraces all combine to make the narrow gorge a jumble of twisted terrain. However, to an experienced walker progress is not difficult. We walked down Tapeats Creek to the Colorado without drawing a deep breath, making the trip in an hour and a half. While we did not succeed in getting down to the Colorado itself because of the unusually high water, we were within plain sight of it and can state that reaching the river is not an impossibility in September or October, when the water is low and the stream navigable on foot.

Tapeats Creek follows a snaky course, and its sloping bottom keeps it tumbling along at a rapid rate. We can say positively that, contrary to frequent reports, there are no waterfalls in this part of the main stream, though there are reports of one farther upstream. There are many short rapids that drop two to four feet, but these can hardly be called falls. Nearing its junc-

▲ Looking out of Tapeats Canyon toward the Grand Canyon and the South Rim beyond. Tiny Tapeats Creek in foreground is actually more than 30 feet wide

▼ Tapeats Creek steepens its incline sharply as it approaches the mighty Colorado. Throughout much of its course, its boulder-strewn channel is turbulent and angry. But at low water, the route would be passable right down to the Colorado

ture with the Colorado, the incline increases rapidly, and the stream hurdles over a rough course of low terraces and boiling rapids. Throughout the major part of its rampaging course, it is a boulder-strewn cauldron.

While the creek is generally reported to be 75 feet wide, we found from actual measurements that it falls far short of this figure. We measured the stream at the widest spot we could find, where Thunder River joins it, and it measured a modest 38 feet. From various other measurements, we estimated that its average width from beginning to end probably does not exceed 25 feet. However, it discharges a tremendous volume of water, and no doubt the spectacle of this racing torrent has exaggerated the size of the stream to persons sighting it from the high rim. The conclusion could easily be reached that the foaming cataract is of floodlike proportions.

While the facts about the river, its springs, and its falls have been highly romanticized, the exciting tales concerning the fishing are genuine enough. The stream abounds in finned whoppers whose size and avidity are fabulous. Looking at such fishes, we could appreciate why the packer-guides are able to command outrageous prices for packing fishermen into the canyon. The only bait required—the fierce-looking little insect called hellgrammite—is found in the stream itself, under the rocks.

The region has been a happy hunting ground for locals, who have had the fishing to themselves for years. Even so, only a few dozen persons have visited Thunder Canyon in the years since its discovery in 1904. A crude register in the canyon shows a total of only 50-odd names—all local residents. No entries appear between 1940 and 1947.

The scarcity of visitors over the years has permitted the trout,

Continued on page 284

The Spin OF THE SEA

Symbolic of restlessness throughout the ages, the oceans circulate relentlessly on their ordered paths, shaping the course of history and affecting the destiny of nations

By N. J. Berrill
McGill University

EVEN to those who know them not, the oceans are restless, and in the affairs of men there is a tide to be taken at the flood. The ebb and flow of the seas, pulsing in rhythm with the sun and the moon as they pull together or in opposition, has entered the mind and literature of mankind. For centuries the glamor of distant lands and the thought of wind-filled sails have caused boys to run away to sea.

As the wind blows, so the water moves. The ocean currents are set in motion not only at the surface but in layer after layer, until even in the cold and dark abyss, the waters flow slowly but steadily over the deep-sea ooze. The whole enormous mass of the ocean is in everlasting movement, swept by the high winds above, deflected by continental shores, warmed by the equatorial sun, and cooled by polar ice, but above all, spun by the spinning earth.

Each of the seven seas spins slowly about itself like a great Catherine wheel, each in its own way, with streamers swinging away from the rim. The winds help set the water in motion, and the earth's rotation turns the direction of flow to the right in the Northern Hemisphere, to the left in the Southern.

For the western world the North Atlantic has become the best known ocean, and each of the various currents that make up the great ocean wheel has played its part in the destiny of nations.

The southern half of the wheel is formed by the Canaries Drift, southwest from the Straits of Gibraltar. Farther along, it swings west to northwest toward the Caribbean and Antilles and becomes known as the North Equatorial Current. This was the course that Columbus sailed and also those that followed him for the gold of the Spanish Main. On their way they saw tropic birds, tuna fish, and dorado, or dolphin fish. Columbus, in his diary, also noted seaweed, and crabs with the weed, far from land. He was, in fact, sailing with the wind and current along the southern edge of the wheel, and the weed that he saw came from the great eddy that forms its center, known the world over as the Sargasso Sea.

The Sargasso Sea was probably known in legend long before Co-

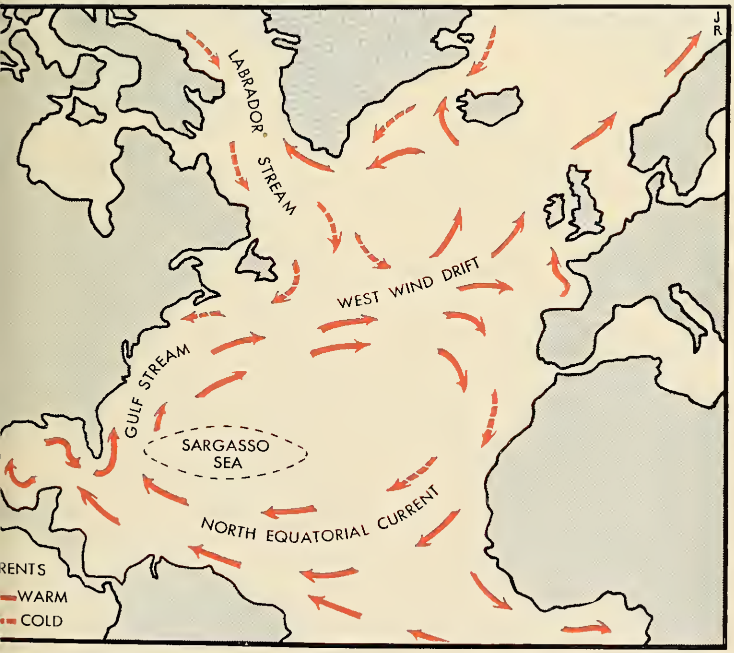
Philip Gendreau photo

◄ MANY taste the violence of the sea where breakers beat upon rocky shores. But more momentous in the affairs of man are the ponderous currents that stir it tirelessly throughout its farthest reaches lumbus, even to the Phoenicians. It is a dark translucent blue, highly saline, with innumerable patches of yellow-green floating seaweed, sometimes matted together acres across but more generally scattered. It is an area of slowly turning or still water where sargassum, or gulfweed, accumulates. The weed propagates by the vigorous growth of its yellow fronds, breaking up into parts as its weight increases or waves disturb it. Old growth sinks, new sprigs with their bladders rise buoyantly to the surface. While the sargassum weed is probably descended from a rock-fast form similar to one now found in the region of the Gulf of Mexico, the great masses in the Sargasso Sea are self-sustaining, growing vegetatively and vigorously, forming no spores and in other ways exhibiting a complete adaptation to a floating, drifting existence far remote from shore and shallow water.

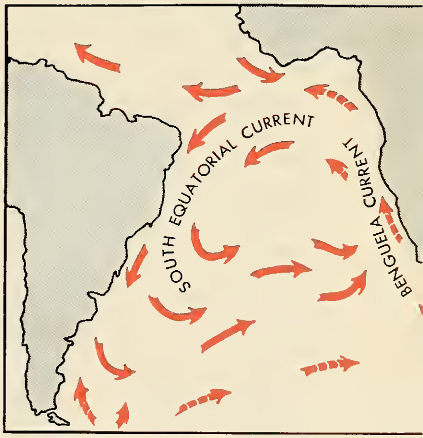
Whatever its source and however well the Sargasso Sea maintains itself, it is something more than an enormous eddy 1000 miles from any land, and it is of immense age. The weed shelters a host of small sea animals—specially adapted crabs and other crustaceans, angler fish camouflaged like the weed, sargassum anemones, worms, and a host of others, all symbolic of the semipermanence of their peculiar world. The sargassum fish, or angler, not only resembles the weed but can quickly change its patterns and shades as it changes its environment. Like other fishes of the same group, it has a "fishing rod" with "bait" extending from its forehead and a tremendous gape to its jaws, so that it can take in fish almost as large as itself.

The Sargasso's northern rim of flowing wind and water is far more strident than the tropical siren of the south. Driving north from the Caribbean and Gulf of Mexico, the Gulf Stream pours out through the narrow straits of Florida. Then it flows to the northeast along the course of the continental shelf and finally swings across the whole span of the Atlantic as the West Wind Drift. This completes the circle and brings the water from the warm cauldron of the West Indies and the equatorial Atlantic to the shores of western and northern Europe.

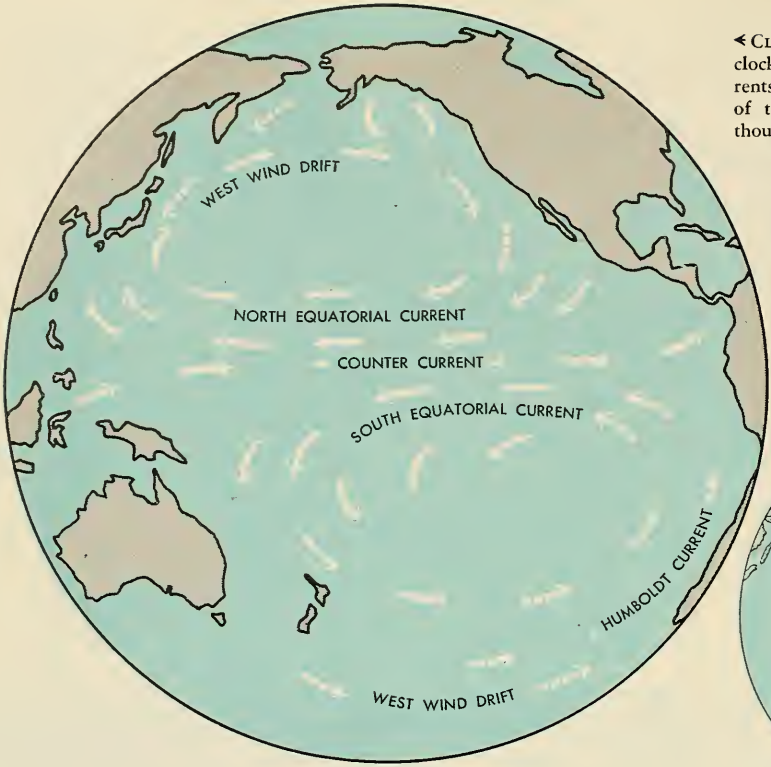
The stream driving between Cuba and the Florida Keys is equal to about one thousand Mississippis where the river enters the sea. Beyond the straits, the stream is reinforced by the Antilles Current, swinging up from the southern and western rim of the Sargasso Eddy. This, however, is not the only contribution of the Sargasso Sea to the Gulf Stream. The great Sargasso Eddy, circulating clockwise, rolls from the outer margin in toward the center, then down into the depths and out toward the margin again at a lower level. A vortex is created like that of a whirlpool, though on a gigantic scale, concentrating the sargassum weed toward the center and carrying warm water down into the depths. This water warms the colder layer beneath and draws it out toward the northern edge of the Sargasso Sea. This low-level current, flowing out from the vortex, discharges more than twenty million tons of water into the Gulf Stream each second.



Most familiar of the great circular urrents that flow in all the oceans is he Gulf Stream. Part of it flows past ngland and Norway, but part turns outhward to meet the North Equatorial urrent and thus complete the circle

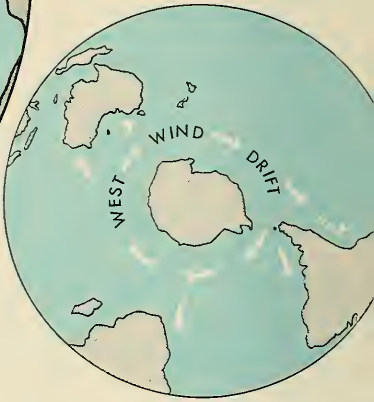


➤ South of the equator the currents flow counterclockwise. The South Equatorial Current turns southward past Brazil to the latitude of Uruguay and Argentina and then flows eastward to join the Benguela Current



◄ Clockwise in the north, counterclockwise in the south, the chief currents of the Pacific resemble those of the North and South Atlantic, though on a larger scale

▼ Around the Antarctic Continent, the sea moves continually eastward, in what is known as the Antarctic West Wind Drift



What is produced must be consumed, and the great flow of the warm Gulf Stream eventually reaches high latitudes in the region of Spitzbergen. There it becomes cool and slowly rotates about another sinking center, falling to the sea floor and moving back toward the equator through the oceanic abyss. Tropical heat and polar cooling thus add a vertical wheel system to the spinning spirals of the surface.

Except for this system, western civilization would have remained an essentially Mediterranean society, for it is the Gulf Stream and its offshoot, the North Atlantic Drift, that have brought a temperate climate as far north as the Arctic Circle in Norway. To recognize this, it is only necessary to realize that on the two sides of the Atlantic, Labrador and Denmark lie at the same latitude.

Thus the temperate Gulf water, entering the North Sea and the Norwegian Sea, made the bordering lands attractive to man. At the same time, however, the prevailing opposition of the wind and currents discouraged all but the most hardy from attempting to sail west. In fact, most of the expeditions were of short range, to Britain, the Faröes, and Iceland; thence to Greenland and the Vinland of Eric the Red. It was only this last venture that may have had the assistance and not the opposition of nature, for the Greenland Current and Labrador Stream flow south to the American side of the North Atlantic.

These are cold, polar currents streaming south to replace warmer water dragged across the Atlantic along the rim of the Gulf Stream, and they bring semiarctic conditions to the bordering lands, at least in winter. But they also create one of the greatest sea fisheries in the world. The Grand Banks of Newfoundland are part of the submarine plain, or continental shelf, bordering North America in this region. It is here that the cold southward-flowing Labrador Stream meets the warm subtropical waters of the Gulf Stream as it flows to the northeast. As a result of the convergence, the rich surface water from the north sinks to the sea floor and establishes ideal conditions for the fisheries. In this region where the warm and cold waters come together, a cold wall of water effectively forms a barrier to many southern forms of life. At one time a U. S. Coast Guard Cutter lying across the cold wall found the sea temperature at the bow to be 34 degrees and at the stem 56 degrees F.

Such a sinking of cold waters brings to the fore the three-dimensional character of the ocean currents. The surface spinning of the North Equatorial Current and the Gulf Stream, with the Sargasso Sea as its eddy, has its counterpart in a slow up-and-down rotation of waters. The cold, heavy water from the north sinks to progressively greater depth as it moves south beneath the Gulf Stream and flows slowly across the floor of the ocean toward the equator. In the tropical zone, surface water is continuously being warmed and evaporated, so that water continuously rises from below to replace it, drawn eventually from polar sources.

Accordingly, surface water and deep water in the same area may have little in common and may differ in direction and rate of flow, in temperature and salinity, and in qualities dependent upon the penetration of light. In a way partly understood, part mystery, the eels of two continents have exploited the North Atlantic System. The mature eels of both America and Europe enter the sea and by some means find their way through cold dark waters, across thousands of miles, to breed in deep water below the western part of the Sargasso Sea and probably to die. How eels, or any other fish for that matter, can sense even the existence of currents over the oceanic abyss is obscure, unless they can follow the demarcation line between two adjacent streams of salt water, differing perhaps a little in temperature or salinity.

The sweeping of the young eels by the Gulf Stream, on the one hand toward the American coastline and on the other across the Atlantic to the European coasts, is a tale well known and often told, but occasionally stranger things get caught up in the same maelstrom to make outlandish voyages. During the hurricane of 1900, the coffin of the actor Charles Coghland is said to have been swept out to sea from Galveston, Texas, apparently to drift in the circulating waters of the Gulf of Mexico until it was drawn into the outpouring Gulf Stream between Cuba and Florida. Thence it floated northeast until by some chance it was blown from its transatlantic course into the mouth of the Gulf of St. Lawrence, to come ashore near the actor's old home at Prince Edward Island, a journey of some two thousand miles!

In more recent years, a mysterious microscopic menace of the sea moved up the Atlantic seaboard from southern waters and later crossed to Europe. First appearing in 1930, it attacked the eel grass in innumerable bays and estuaries in Florida, and in 1931 it swept northward in a destructive wave. By 1932, the eel beds had vanished from the coast from Cape Hatteras to Nova Scotia. It crossed the Atlantic with the West Wind Drift, traveling at much the same pace as the larval eels, and first affected the western end of the English Channel toward the end of 1931. Late in 1932, the first marked effects were evident. When it invaded the sheltered waters of northern Europe, the eel grass died, the supporting banks broke up, and a rich, shallow-water fauna disintegrated. Even migratory geese and other birds suffered as they flew south from summers in the arctic, descending in vain along the coast to feed off the stricken beds.

Water movements have been investigated to a great extent by the method of casting sealed bottles adrift in the sea, containing information as to the place and time of liberation. Recently one such drift bottle, set free at Sidney, Nova Scotia, arrived at the coast of South Australia after possibly the longest bottle voyage known. To have accomplished this, the bottle must have drifted northward and eastward across the Atlantic with the Gulf Stream, then south with the Canaries Stream to the Equatorial Current. Possibly some storm blew it from the North Equatorial into the South Equatorial Current, so that it entered the Brazil Current instead of ending up in the region of the Sargasso Sea. The Brazil Current carried it down the east coast of South America toward Cape Horn. Here it must have been caught up in the sweep of the Antarctic West Wind Drift, to be carried east across the South Atlantic and Indian Ocean and finally to reach the shores of Australia.

Each of the oceans has a system of currents like that of the North Atlantic, and the similarity is so clear that there is plainly a general scheme. The origin of the movement is from the great equatorial streams that flow from east to west. The motive force comes from the continual action of the Northeast and Southeast Trade Winds, which drive the surface water of the equatorial belt continuously to the west. The force exerted by the earth's rotation on bodies free to move on its surface is further seen in the deflection of these broad currents north and south of the equator. In the north the deflection is to the right or clockwise; in the south it is to the left or counterclockwise.

The North and South Atlantic show this clearly. In the north, the North Equatorial Current (the part of the Equatorial Stream lying to the north of the equator) flows west and spins to the north as the Gulf Stream. The part lying south of the equator, the South Equatorial Current, also flows west, but it turns to the south at the coast of Brazil, and its warm waters extend their benevolence far down the eastern coast of South America.

In the Pacific there are no land masses to confuse the picture, and the great spinning movements of the North and South Pacific are well developed. In the North Pacific the circulation resembles that of the North Atlantic. The North Equatorial Current flows west across the waist of the Pacific to the Philippines, thence northward as the "Black Current" of Japan, and eastward to North America. The circle is completed by the cool California Current flowing southeast to join the eastern end of the Equatorial Stream. Kamchatka, incidentally, is kept cold by a replacement current comparable to the Labrador Stream.

In the South Pacific, the reverse system is seen again, and in some ways this system is of greater interest. Matching the Cold Benguela Current of the South Atlantic, the Humboldt Current swings north along the west coast of South America, carrying water of subantarctic origin almost as far north as the equator. Near the equator it turns west as the South Equatorial Current, and the circle sweeps past the Galápagos in a grand arc through the Polynesian Islands.

The cool waters of the Humboldt Current hold more oxygen and carbon dioxide than most other waters of similar latitudes, and they also receive much organic matter from the outpouring of the coastal rivers. From these and other causes, the current is abundantly rich in microscopic vegetation and in innumerable small marine animals that depend upon it. This dense community in turn supports an almost infinite population of fishes, among them the abundant little herring-like anchovetas. While the coastal fisheries of Peru and Chile are important, sea birds are the chief direct benefactors, especially the guanay (a cormorant) and pelican. The guanay feeds mainly upon the anchovetas and other small fish and crustaceans.

These multitudes of birds breed and rest on the coastal islands and have done so for so long that their excrement, or guano, has accumulated in enormous masses and has become world famous as a source of nitrate for fertilizer. Much of the prosperity of Peru depends upon this resource and therefore on the continued protection of the birds.

The guanays are of antarctic origin and have probably nested for more than 100,000 years on the coast and islands of Peru. Only the cold temperature of the Humboldt Current makes it possible for them to exist so far north.

Occasionally, at irregular intervals, a warm tropical current intrudes between the Peruvian coast and the cold water, with disastrous effects. The rise in temperature in the coastal waters kills the fishes and smaller organisms, producing such decomposition and liberation of hydrogen sulphide as to blacken the paint of ships. When this happens, the guanays suffer accordingly, and a few years ago millions lost their lives from malnutrition.

The penguin is another antarctic sea bird that has exploited the presence of the Humboldt Current, thriving on its abundant fish and tolerating tropical latitudes only because of the cool water. There are, in fact, two penguins that have migrated into the tropical latitudes, the Peruvian penguin and the even more adventurous Galápagos penguin, which is actually in the equatorial zone.

Currents of diverse origin usually do not mix, and William Beebe, on his Arcturus Expedition to explore the Humboldt Current, actually saw the line of water separating two westward-flowing streams of warm water some 200 miles southeast of the Cocos Islands, close to the northern edge of the Humboldt. Flowing at somewhat different rates and with several degrees difference in temperature, the junction created a rip of foaming water against which all the floating jetsam for miles was held, including logs of wood covered with barnacles and sheltering crabs and small shore-loving fish. The rip was followed for 100 miles or so and was the focus of all kinds of animal life. As many as 38 species of trees, plants, and seeds were found. The steady flow to the westward at about two miles an hour would eventually carry the survivors of many shore and even land forms across vast spaces of the ocean, perhaps to colonize islands in their path.

The westward sweep of the currents from the coast of Peru has given rise to much speculation as to whether the islands of the Pacific were colonized by natives from Asia or South America. The recent voyage of the raft "Kon-Tiki," drifting 4000 miles with the South Equatorial Current from Peru to the Low Archipelago, shows at least the possibility of the western passage.*

There is one remaining spinning system that stands apart. This is in the antarctic. Here the waters flow in the same direction as the earth rotates on its axis, truly reflecting the spin of the earth. In other words, while the earth is constantly turning toward the rising sun, the waters of the Antarctic are turning even faster in the same direction, as though to hurry on ahead. The flow of water is due to a number of factors, but one of the most powerful is that the ocean in the temperate and tropical latitudes is warmer and lighter, and the ocean surface there is actually higher than the cold water to the south. Consequently it flows down a gentle slope toward the antarctic, where the earth's spin swings it toward the east. It is also aided in the same direction by strong westerly winds forever blowing from west to east between latitudes 40 degrees and 60 degrees S., blowing from the right toward the warm

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* See "Voyage of the Raft 'Kon-Tiki,'" by Thor Heyerdahl, NATURAL HISTORY, June, 1948.

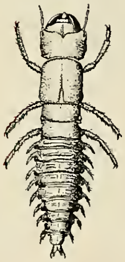
Fish Fl

Fluttering about on lacy wings, it shows little resemblance to the spiny, underwater pirate from which it developed

By EDWIN WAY TEALE

Photograph by the author

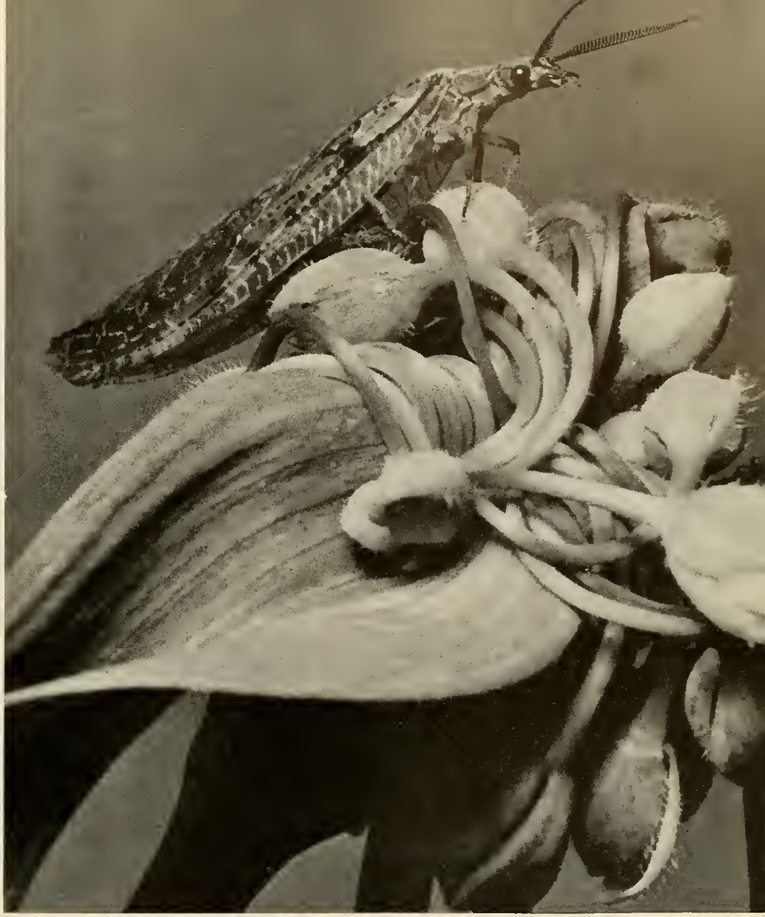
LIKE the mayfly and the great silk moths (Polyphemus, Cecropia, and Luna), the fish fly, *Chauliodes pectinicornis,* lives but a short time and probably does not eat at all. It emerges late in spring. The insect shown here was photographed in mid-June. On lacy wings that are gray-brown and spotted with white and have a spread of as much as three and a half inches, the fish fly flutters about



◄ THE LARVA of the fish fly is a horrendous creature quite unlike the winged adult it will become during the hours of darkness. Females deposit masses of from 1000 to 2000 oval, reddish-brown eggs on branches and leaves and stones that overhang the water.

From these eggs hatch larvae that resemble minute spiny worms. They drop into the water to live for many months as predaceous, aquatic creatures. Lurking under stones or clinging to submerged logs, they obtain oxygen from the water through gills and grow until they reach a length of an inch and a half. They are closely related to that favorite food of the bass, the larva of the Dobson fly, variously known as the hellgrammite, the flip-flap, the alligator, the water grampus, and the conniption bug. But, unlike the hellgrammite, which lives under stones only in rapids and riffles and swift-running streams, the young fish fly is often found in sluggish water.

At the end of its aquatic life, it creeps up the bank to pupate under a log or stone or in the earth. The cinnamon-brown adult emerges with long antennae "feathered" on only one side. This feature gives the insect its colloquial name—"The Comb-Horned Fish Fly." Rather secretive, it clings quietly to vegetation throughout the day. Because of this habit, it is observed but rarely, in spite of its large size, striking appearance, and wide distribution east of the Rockies.



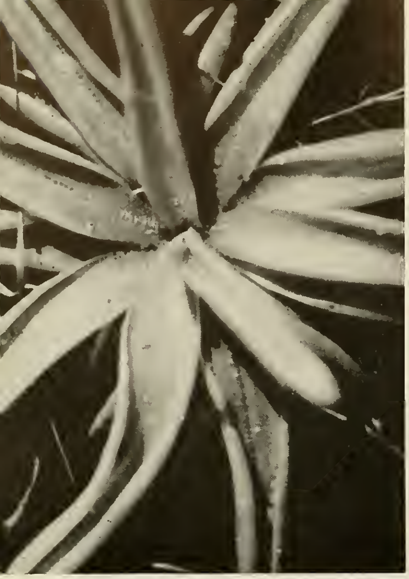
▲ THE FISH FLY (*Chauloides pectinicornis*) lives in its adult form only a short time and probably never eats

rising sun. Thus it is called the Antarctic West Wind Drift.

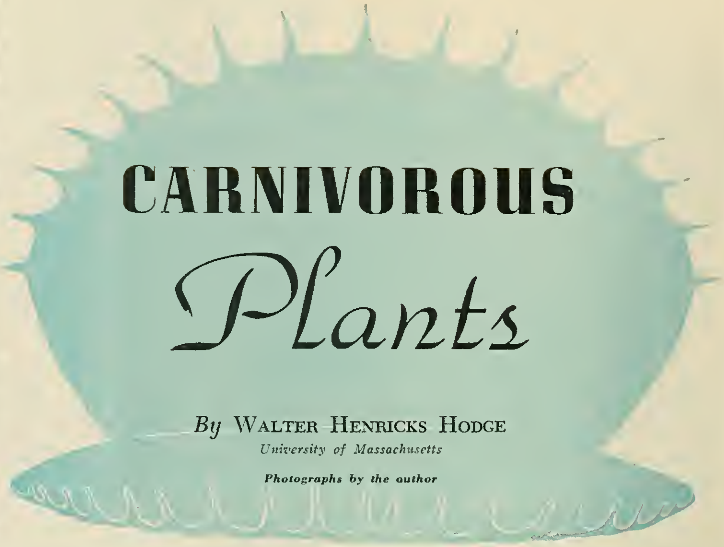
The Antarctic Drift flows steadily around the Antarctic Continent without let or hindrance, little known and little traveled except for whaling ships and an occasional antarctic expedition. The giant whales have vanished from the northern hemisphere, only their smaller cousins surviving, and now in the West Wind Drift of the antarctic alone do the "great whales go sailing by, round the world for ever and aye." Apart from the effect of the slaughter by floating whale factories, the whales abound in these waters because their food is abundant. The largest whales feed mainly on relatively minute shrimp-like forms that thrive in the cold nutrient waters of the far south. Where these organisms are, the whales are likely to be.

Even in the Drift, however, there are currents within currents, and these are utilized by the whale shrimps to limit their own particular drift. Just as an expert balloonist can guide his direction of travel by controlling his altitude, so the shrimps and other small forms keep within the bounds of the Antarctic Drift. They are swept slowly to the north from the region of the Antarctic Continent, and as they approach the warmer water they sink from the surface layers into deeper water. There they drift with the countercurrent moving in the opposite direction, south to the Antarctic Continent. In this manner they tend to circulate slowly to the north and south, though all the time being swept to the east and round the world as long as they live.

So the earth turns and the seas spin, affecting profoundly the lives of all that live upon the land or in the immensity of a salt and watery world.



▲ ONE OF THE BUTTERWORTS, showing its rosette of tongue-shaped leaves. Approximately 25,000 glands to the square centimeter pour out the sticky "butter." This substance holds and digests the luckless insects that get caught (black dots visible here). The edges also curl inward to aid in digestion



CARNIVOROUS *Plants*

By WALTER HENRICKS HODGE
University of Massachusetts

Photographs by the author

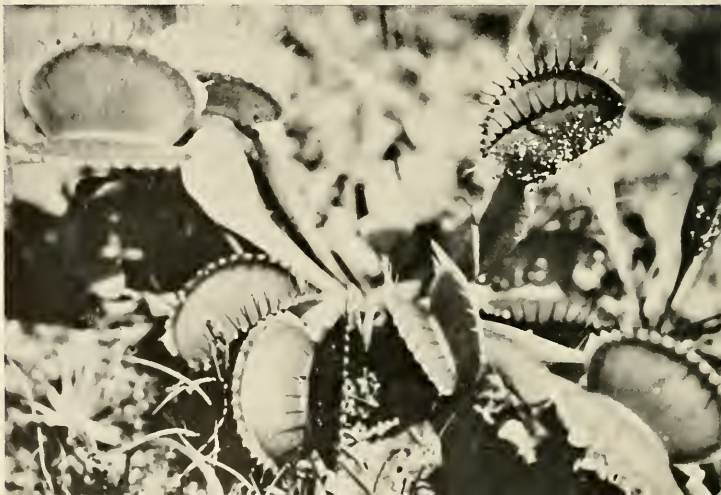
The most curious "food-faddists" of the botanical world are an assortment of plants that capture and digest insects instead of deriving their nourishment from the soil

INSECTS that eat plants are common enough; in fact, to some of us who are gardeners they are too common. But plants that eat insects are freaks perhaps unsurpassed in interest by anything else in the green world. Among the majority of plants, the process of food getting is so orthodox as to be unspectacular, and so it is difficult to believe that there are plants that feed upon juicy insect steaks. Yet such plants are not uncommon throughout the world from the arctic to the tropics. Plants of this sort are called carnivorous or insectivorous. Some of them actually possess a kind of vegetable "stomach," comparable in its action to the stomach of an animal.

These green insect-eaters are, of course, sedentary and thus, unlike roving animals, are unable to run after and catch their prey. This fact troubles them not in the least, for they have evolved some of the most sensitive snares, diabolical traps, and wells-of-death imaginable. With these varied tricks up their vegetable sleeves, they can be assured of an almost constant and fresh meat supply.

Carnivorous plants are eminently successful in their unusual mode of life. In fact, their leafy parts have at times become so modified that they no longer possess sufficient chlorophyll for normal food synthesis. Instead, their leaves serve as bait and are colored with attractive hues of red or purple. They are so bizarrely modified that they might be mistaken for flowers. Furthermore, these plants are so independent of the normal sources of nitrates that they are able to inhabit extremely poor soils. About all they need from the substratum is water. Some, indeed, are wholly aquatic, such as the majority of bladderworts; but most of them must be sought in bogs or marshes, where

▼ VENUS'S-FLYTRAP, with its curious, colorful, quick-acting leaves



their weak root systems, acting merely as water pipes, are often buried in nothing more than wet mats of moss.

Of all the carnivorous assemblage the sundews, belonging to the genus *Drosera*, are the most widespread, the most numerous, and apparently the most successful—at least if abundance, world-wide dispersal, and number of species are a measure of success. Despite its ubiquity, the little sundew, because of its size, is not well known by Mr. Average Man. Yet on most every sphagnous bog, near many a springy rill, and even on many a high Andean mountainside, it spreads its expectant whorls of tiny, frequently spoon-shaped leaves. Befitting its size, its prey consists of insignificant winged creatures—gnats, midges, mosquitoes, and the like. Woe betide any dipterous biplane that sails unwarily into its glistening leafy orbs, for it is soon ensnared in viscid blobs of glue, nature's original flypaper. Charles Darwin, whose researches on insectivorous plants are classical reading, considered the leaf of Drosera one of the most "incredible and wonderful" things known to him in the whole field of botany.

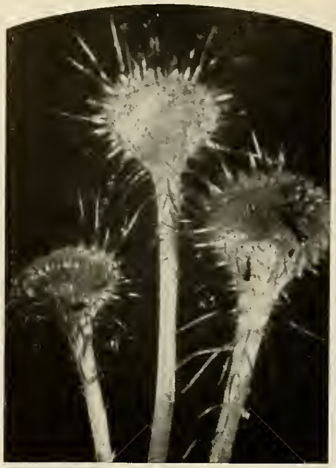
It pays to look closely at the structure of such a morphological gem. Sundew leaves vary in shape, being round, hairlike, or spatula-shaped according to the species, but all have a similar basic structure. Those of the common sundew (*D. rotundifolia*) are typical. Flat, platelike blades with the diameter of a lead pencil are borne on elongated, tapering petioles. From the upper surface and edges of these leaves arise several hundred green or purplish hairs, sometimes called "tentacles," which serve as the traps for insects. On the central part of the leaf the tentacles are short and stubby, but as one progresses to the margins they become much longer. Each hair is clublike at its tip, the swelling being a tiny oval gland possessing the complex digestive properties of secretion and absorption. When functioning properly, each tiny hair produces sticky drops of a fluid that glisten in the sunlight, giving to the leaf as a whole the appearance of an elfin crown studded with dozens of shining diamonds.

What happens to the gnat that flops its six-footed landing gear into this sparkling orb? Plenty! Not only its legs but also its wings and body are hopelessly ensnared by this living vegetable flypaper. In short, Mr. Gnat is in the hands of a green octopus, whose tentacles at the first touch of the insect begin a characteristic slow, bending action. This brings the hair tips as well as their trapped prey into the center of the leaf, until the leaf looks like the inflexed fingers of a clenched hand. All the hairs, with all their glands, can now effectually contact, hold,

▲ OVER the dangerous area of the glandular blade wanders an inquisitive ant. The Venus's-flytrap in the middle has already caught an ant and will soon digest it

➤ THE LEAF CLOSES QUICKLY, and the ant has little chance to escape from this curious botanical "stomach"

▲ A COMMON SPECIES OF SUNDEW (*Drosera rotundifolia*), spreading its expectant whorls of tiny spoon-shaped leaves



▲ THE GLANDULAR HAIRS have folded upon a tiny insect at extreme left. On the other two leaves the hairs are wide-spread. (*Drosera rotundifolia*)

and digest the insect morsel; and the hairs remain in this position until digestion is effected.

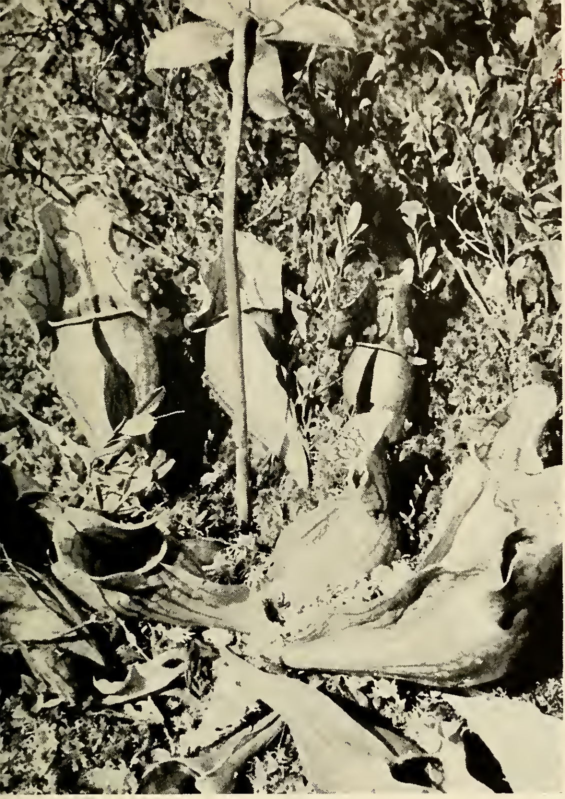
The leaf is now acting for all the world like an animal stomach, for in the temporary enclosure formed by the hairs, the glands discharge a digestive juice possessing all the properties of pepsin, the ferment produced by our own stomachs. This ferment will digest any nitrogenous insect material, and it has even been shown capable of softening such tough substances as cartilage and bone, bits of which have been placed experimentally on the leaves. When absorption is complete—after several days—the tentacles again expand, and the trap is ready to repeat the process.

When we remember that plants have no muscular or nervous tissue, the whole procedure seems remarkable. And the sensitivity of the mechanism that carries it out is perhaps unsurpassed by anything in the whole field of botany. It has been shown that a bit of ordinary hair weighing only 1/78,740 of a grain, pressing on one gland, is sufficient to cause movement of a Drosera hair, yet such a particle on the supposedly delicate human tongue is too light to cause any sensation! Inedible foreign particles, upon touching the surface of a sundew gland, may cause bending, but apparently the leaf soon "realizes" its mistake and reopens quickly. The force of the wind or drops of rain cause no reaction, and so the plant is spared much useless energy; but let food in the form of an insect alight and the glands really react. Thus there is apparently both a mechanical and chemical reaction. Darwin showed that one twenty-millionth of a grain of phosphate in aqueous solution is fully sufficient to cause a reaction. Ten seconds after such an infinitesimal chemical stimulus, a tentacle will show appreciable movement; in ten minutes it may have reached the center of the leaf.

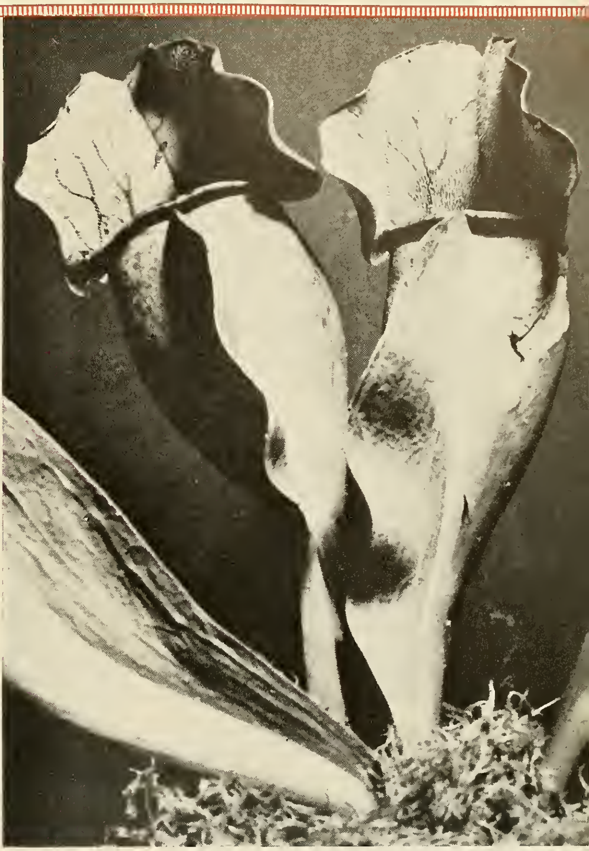
Although *Drosera* is the largest genus of a family (Droseraceae) boasting over 100 species in the temperate regions of both the Northern and Southern Hemispheres, there are other sister genera equally interesting. Most of these are rare plants with a peculiar distribution, often exemplified by local abundance in only one tiny locality on this earth of ours. One such example is a plant that has devised not the flypaper technique but rather a clever mechanical trap. This plant is the all-American Venus's-flytrap (*Dionaea muscipula*), found only on the Atlantic coastal plain, chiefly near Wilmington, North Carolina. On grassy, pine-sprinkled savannas, in the company of gaudy sabbatias, insignificant burmannias, and orange habenarias, this curious plant spreads its leafy rosettes like a bear trap and awaits whatever prey may appear. The leaves of Venus's-flytrap are more spectacular, larger, and much more rapid in action than Drosera's apparatus. Furthermore, they show greater complexity of structure, for the functions performed by the tentacle alone in the sundew are discharged by three different structures in Dionaea.

Each flytrap leaf consists of a flat spatula-like stalk which supports a roundish blade divided by a midrib into sensitive, symmetrical folding halves. The two halves are held open at an angle of up to 80 degrees. The upper surface of the blade is often colored a beautiful red owing to the presence of multitudes of minute closely-packed, short-stalked glands. Their purpose is purely secretive and digestive, although their brilliant color undoubtedly serves as an insect lure. Rising from the surface of each half of the leaf blade are usually three stiff hairs which act as ultrasensitive triggers to set off the whole insect-catching mechanism. To complete the complex apparatus are a series of rigid marginal spines, which interlock like the teeth of a bear trap when the leaf is closed. These are not sensitive.

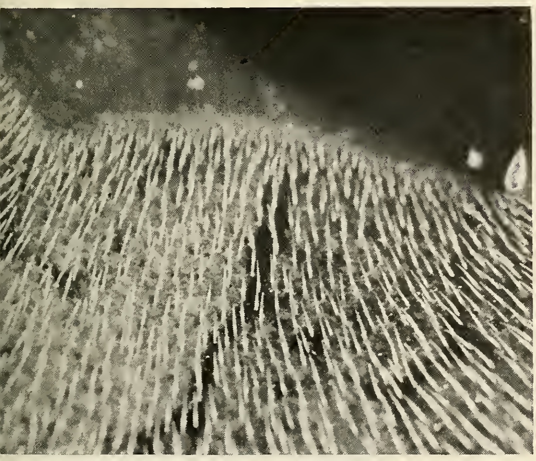
Dionaea is called a flytrap. Actually the plant probably captures more creeping insects like ants, beetles, etc., than it does flying forms. Over the dangerous area of the glandular blade wanders an inquisitive ant. It is usually safe so long as it doesn't brush against one of the upright triggers. If it does, even though the touch be momentary and slight, zip!—and within a second or two (under proper temperatures) the leaf-halves evenly and firmly close. The triggers, hinged at their bases, fold neatly flat against the leaf surfaces while the ant is firmly held. Its body



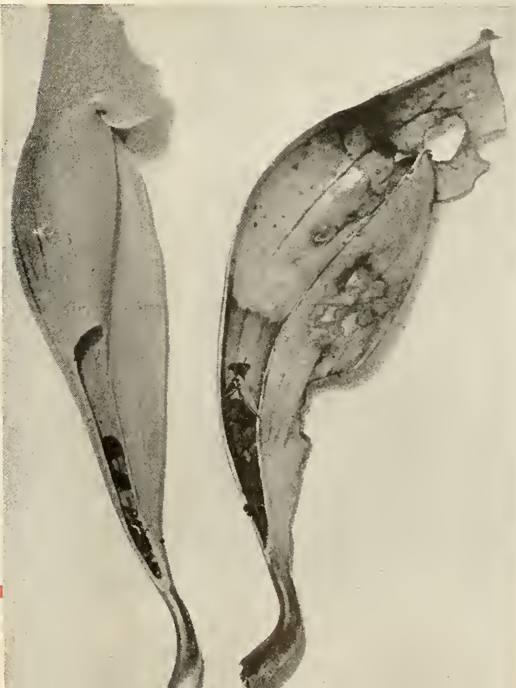
▲ The commonest American pitcher plant, *Sarracenia purpurea,* photographed in a New England bog



➤ The tubular, pitcher-shaped leaves give the plant its name and are the organs that capture and digest insects



▲ All the hairs of the hood near the orifice of the pitcher plant point the same way and form a shoot-the-chutes



➤ When they are cut open and drained of water, the lower portions of the pitchers are seen to be plugged with insect carcasses fluids, if ruptured, provide a necessary incentive for the surface glands, which immediately begin pouring out digestive fluids, and Dionaea's temporary leaf stomach thus goes into action. A week may be required for assimilation, after which the leaf reopens, ready for another mouthful.

Another type of meat-eating plant is seen in the butterworts—various species of *Pinguicula* (Lentibulariaceae). These fraternize with the little sundews on moors, moist peat lands, and bogs; and on the eastern Carolina savannas they may even be found rubbing leafy elbows with the Venus's-flytrap. Butterworts also spread into mountainous terrain, where they may rear their small but colorful snapdragon-shaped flowers from wet rock crannies or springy places.

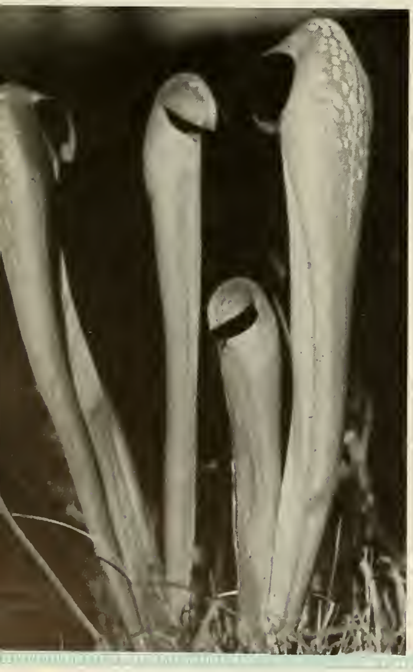
The tongue-shaped leaves of butterwort rosettes look superficially more like normal everyday plant leaves, yet if one gives a leaf a microscopic look, peculiarities appear. For one thing, its whole upper surface is peppered with tiny glands, roughly 25,000 per square centimeter of leaf surface. Any kind of pressure upon the glands by a foreign body causes them to secrete. If, in addition, the object happens to be nitrogenous, as in the case of an insect, they pour out quantities of mucilaginous and acid digestive liquid. The plant gets its common name from the fact that the leaf practically exudes "butter." Pinguicula also has a power of movement shown by its leaf margins. Although these exhibit a more or less permanent inrolling, the effect is increased when insects are stuck on the surface glands. By encompassing them with the margin, more secretive surface is put to work in digestion, and thus a more efficient type of temporary plant stomach comes into play.

Of all the queer insectivorous plants thus far considered, only the butterwort has found a place in man's economy. Shepherds in the Alps have long used its leaves in curing the udder sores of milch cows. The glandular secretion of the blades apparently acts as an excellent antiseptic. And on a Lapland journey over 200 years ago, the great Swedish botanist, Linnaeus, noted that the inhabitants had observed that the secretion of Pinguicula glands acted similarly to rennet. Indeed, if fresh milk is poured over the leaves of the butterwort, a tough mass called *taetmiolk* is formed, which is a favorite dish of those northern regions.

The all-American pitcher plants (Sarraceniaceae), familiar insectivorous plants common in bogs from the Gulf Coast to Labrador, have pioneered their own way of catching insects, and although the shape and style of the traps may vary in the different genera and species, they all follow a basic pattern.

The numerous colloquial names applied to the species of *Sarracenia* —pitcher plant, sidesaddle flower, trumpet, huntsman's horn—aptly describe the hollow tubular leaves that serve this genus as insect traps. Without exception the leaves are attractive organs, often brilliantly colored with purplish-red reticulations or stripes on a green or yellow background. Not only do the leaves of these curious plants resemble flowers in shape and color, but they also mimic them in the possession of nectar glands. These exude fruity-smelling fluids of honey-like consistency, which entice the most reticent of insects from afar. But pitcher plants don't stop with perfume, for in many another way they have made it easy for any insect to buy a one-way ticket to oblivion.

Just suppose a fly catches sight of the leaf of the common pitcher plant, *Sarracenia purpurea*. It immediately attempts a landing, finding to its delight a beautiful plush-like "front porch," the hood, which serves as an admirable landing field. What is more, heavenly odors (at least to an insect) exude from a portal near by. No job to walk toward it either, for all the hairs on the plant door mat are bent



◄Besides a baited path of nectar and a capping hood, this pitcher plant of our southeastern states (*Sarracenia minor*) possesses thin translucent spots of tissue that fool the insects trying to escape by flying (see upper right pitcher leaf). These pitchers are often brim full with captured insects

➤ Southern "trumpets" (*Sarracenia flava*), one of the tallest of the pitcher plants thoughtfully that way! At this point the insect, having reached the sweet-smelling threshold, may be slightly punch-drunk and perhaps even staggering a wee bit on its six wobbly legs. A stumble is all that is now needed, and with it another insect is precipitated down the smoothest and most slippery shoot-the-chutes to be found in nature. At the dark bottom, the insect lands with a splash in water, foul-smelling water, for this is a cistern choked with insect "soup." In many cases the insect's wings become wet, eliminating its chances of flying out. Even if it reaches the sides, its doom is still sealed, for at the water level is another zone of long, downward-directed hairs. The watery fluid exerts a quieting influence and stupefies the prey, for it contains protein-digesting enzymes secreted in quantity by glands on the bottom walls. Epidermal cells in the same region are constantly absorbing the nutrient solution resulting from decomposition and digestion. Pitcher plants are thus really well fed.

In the job of wholesale insect slaughter it must at least be said that Sarracenia is humane; in fact, it has been but recently shown that this commonest of pitcher plants produces a powerful painkiller. Ammonium extracts from the leaves have been used by Philadelphia physicians for over fifteen years as injections, and they are said to be superior to alcohol or novocain in at least three ways: anesthesia from Sarracenia extracts does not produce numbness, does not destroy nerve tissue, and is longer acting.

The leaves of the common pitcher plant are also pitfalls for ground-inhabiting insects, for its pitchers are often deeply sunk in masses of wet sphagnum moss. In such sites only the erect hoods remain unburied. These sunken pitchers are so open to the elements that they are generally full to the brim with rain water, which dilutes the consistency but apparently not the efficacy of the digestive fluid. In most of the other Sarracenias, the hoods are not erect but bent over (like a jack-in-the-pulpit spathe), acting as capping protection to the pitcher mouths. The result is that little if any rain ever enters. What liquid is secreted is limited to the lowermost narrow and basal portion of the tubular leaf. Even with pitchers thus partly covered by a protective cap, the plants are still very effective; in fact, the Lesser Pitcher Plant (S. *minor*) of our southeast, with a helmeted cap and a baited path of nectar running from the ground to the orifice, surpasses all other species in insects captured. Its semidry pitchers are often stuffed with the bodies of ants.

This Lesser Pitcher Plant and the California Pitcher Plant (*Darlingtonia californica*) have, in addition, an interesting device for sealing the doom of insects that might be able to fly out of a fairly dry chamber. This is a "skylight" situated in the crown of the hood. This window is actually a thin, transparent spot in the tissue of the leaf. An insect flying against the window in an effort to escape is, of course, only knocked down again into the well below. Seldom does it find the opening by which it entered.

It is not strange that pitchers full of decaying insect remains should attract carrion insects. In fact, many of the latter perish in their dangerous quest. But the queer thing is that at least some of these carrion seekers actually pass a portion of their life history unharmed in these wells of death. One small fly (*Sarcophaga sarraceniae*) has the knack of passing safely in and out of the leaf traps and lays its eggs among the pitcher's insect remains. The larva of the fly, apparently unharmed and unconcerned by the digestive enzymes of the cistern, feeds upon the carrion mass and then bores through the thicker walls to pupate in the earth.

▲ THE VARIOUS TROPICAL NEPENTHES display giant-sized pitchers, sometimes large enough to hold a pigeon. The nectar-flavored margin curls sharply inward and thus prevents crawling insects from escaping. Note the hood poised delicately above

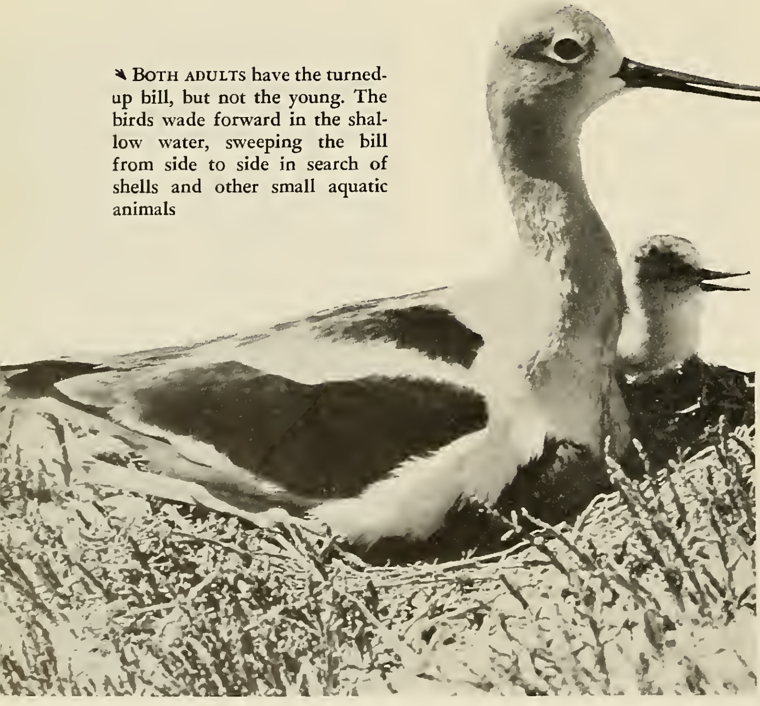
During the recent war, our fighting men in the jungles of Malaya and on the islands of the South Pacific undoubtedly ran across the most bizarre of all pitcher-bearing plants, those belonging to the oriental family, Nepenthaceae. Not unknown in our own country, species of tropical *Nepenthes* are sometimes grown for their novelty in warm, moist conservatories. The plant is primarily a climbing, scrambling one with giant-sized pitchers slung in the air at the ends of the leaflike petioles, like so many Chinese lanterns. In addition to the liquid-filled chamber, pitchers of this genus possess a tiny hood and a honey-secreting margin with a sharply revolute edge, which keeps crawling insects safely within. In general pattern, the leaf of Nepenthes is thus similar to the predatory leaf of the Sarracenias.

Quite a gamut is run from the sundew to tropical Nepenthes, yet these queer insectivorous plants, unrelated though they are, show harmony and similarity in at least one point—they have investigated the possibilities of a new kind of food supply, and, what is more, they have all apparently made good.

▲ Avocets in flight in the type of country where they are most at home

Avocets Have Turned-Up Bills

Scenes at the Bear River Wildlife Refuge in Utah
depict the home life of one of our most attractive shore birds



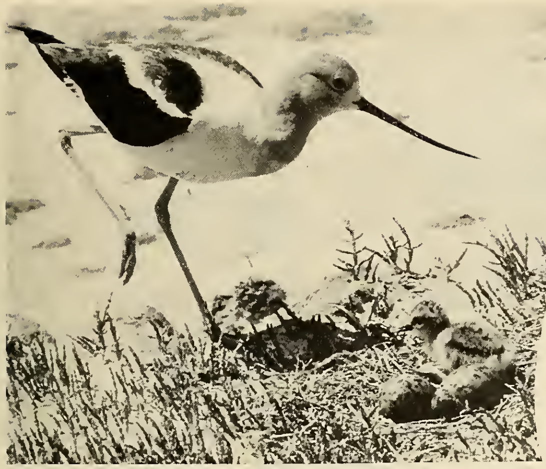
➘ Both adults have the turned-up bill, but not the young. The birds wade forward in the shallow water, sweeping the bill from side to side in search of shells and other small aquatic animals

A photo series

By

Hugo H. Schroder

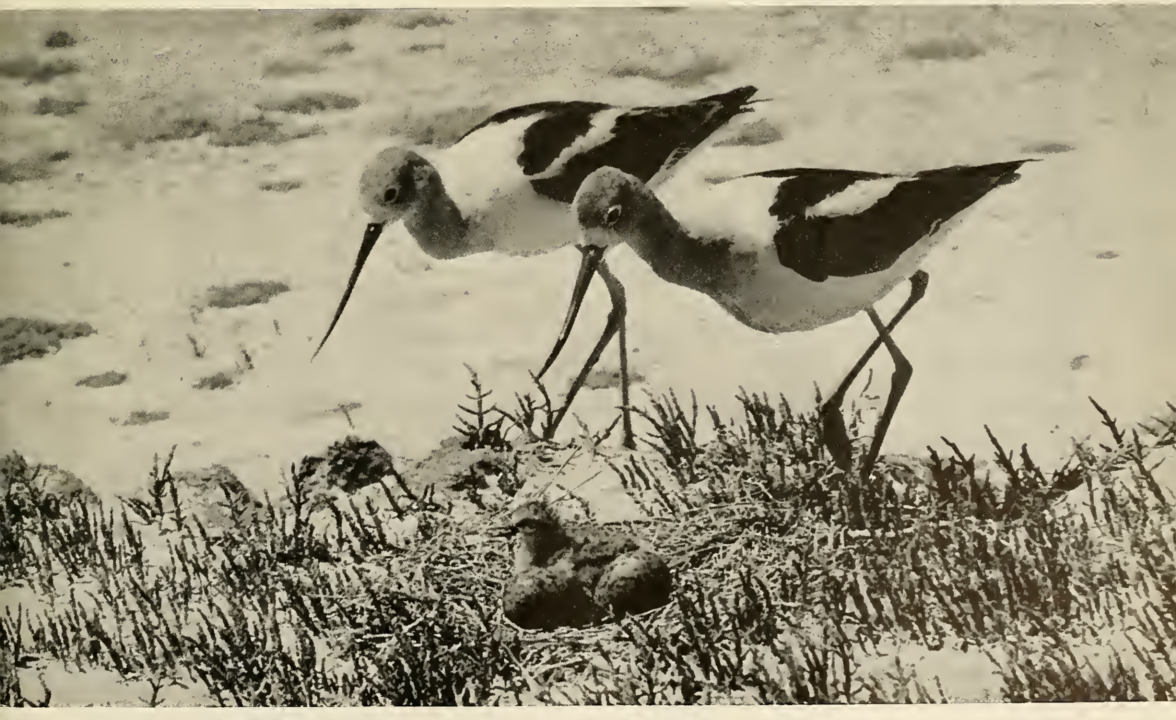
Its sharply contrasting colors, graceful form and carriage, and long upturned bill make the avocet a bird of distinction. It is rare east of the Mississippi, being most commonly found near the prairie ponds and alkaline lakes of the interior. It constructs its simple nest on the ground among grass or low herbage, at not too great a distance from the water. Three to five eggs are laid, although occasionally more than one female will lay in a single nest.



▲ One of the parents walking to the nest, which contains two eggs and one newly hatched youngster

➤ The adult's plumage is black and white, its head and neck brown. The legs are light blue

▼ The male and female are very much alike. The female is slightly smaller on the average, but some females are larger than some males



Natural History
CRYPTOMAZE

INSECTS, *By* EDWARD DEMBITZ

In this puzzle you are given a set of definitions, each with a set of blank spaces (Part I), and a diagram to be filled in (Part II).

PART I. Each definition is a clue to a word whose letters you are to insert in the blank spaces preceding the definition. These words appear in recent issues of NATURAL HISTORY Magazine.

6 31 28 19 16 35	*A mammal that a dog is named after (German)*
1 13 32 37 14	*What oysters do before they R in season*
30 13 16 7 25 2 21	*To pursue a hobby that keeps one underground (colloquial)*
3 9 14 34 22 10	*"Reverent" insect; the female eats the male*
29 33 15 27 4 26 18 7	*19th century astronomer (1818-1889); one of first women elected to Hall of Fame*
1 21 20 5	*Predatory bird, enemy of baby penguins on the Snares Islands*
18 5 28 8 6 25 19	*A male or female beetle, despite the name*
38 24 22	*A favorite of crossword puzzles and of Hawaiian culinary art*
17 36 15 31 2 12	*Australian bay named by Capt. Cook for a branch of biology*
27 36 29 17	*Adornment for the rooster, larder for the bee*
9 23 19 24 14 32 20 34	*Nautilus-like relative of the octopus; also a shipmate of Jason*
11 24 23 3 22 27 5	*A genus of ants, producers of pungent acid with similar name*
20 38 9 30	*An Australian tree that ensnares birds in its sticky fruit*
37 4 12 10 31 4	*An African weaverbird given to raids on grain fields*
11 33 35 26 11 7 8	*A light-producing beetle*

Copyright 1949 by Edward Dembitz

The contest is open to everyone except employees of the American Museum and Doubleday and Company, and their families.

PART II. When you have filled in all the letters in Part I, transfer them to the proper numbers in the boxes in the diagram below.

1	2	3	4	5	6	7
8	9	■	10	■	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	■	29	■	30	31
32	33	34	35	36	37	38

When the diagram is completed, the white spaces will form a word maze containing at least 18 names of INSECTS. To find one of these insects, begin with a letter and move from space to adjoining space in any direction, including diagonally, until the name is spelled out. Do not pass through shaded spaces while forming names. Do not form double letters by jumping up and down on the same square. Do not skip squares in the middle of a two-word name.

THE PRIZES. *The three contestants submitting the largest number of names of insects fitting this puzzle will each receive a copy of Ralph B. Swain's* INSECT GUIDE, *recently published by Doubleday and Company.*

Names of insects must appear in bold-faced type in the main A-Z section of Webster's New International Dictionary—*1948 (unabridged) in order to be eligible. Names in bold-faced type below the line at the bottom of the page are allowable. Different names for the same insect will be accepted. So will variants, alternative spellings, and scientific or technical names, providing they appear in bold-faced type.*

Flagrant disregard of the rules will disqualify a contestant.

In case of ties, duplicate prizes will be awarded.

Entries must be postmarked on or before July 1 and be received by July 6, 1949. You need send only your list of insects, not the "checkerboard."

Winners and their scores will be published in NATURAL HISTORY *for October, 1949.*

THUNDER RIVER *Continued from page 269*

planted as an experiment by the Forest Service several years ago, to reach what is well-nigh the limit of size for stream fishes. One fisherman in our party took the limit of fresh rainbows in 30 minutes. The fish ranged in size from fingerlings to 21 inches, the prize catch being a speckled beauty that weighed 2¾ pounds when cleaned.

There is no likelihood that Thunder River ever runs dry, and the presence of the fishes bears this out. Originating as it does in springs, the stream has no inlet through which fish could enter. Hence it is logical to assume that the stream varies little in volume. Low water could not support fish of such proportions, and it is most unlikely that the fish fight their way upstream from the Colorado, since its muddied waters have never been known to support sizable trout. It is doubtful that Thunder River trout migrate. Once established in the stream, it is likely that they remain within its narrow confines, which probably accounts for their huge size.

Taking a critical view of the

fishing, perhaps a word of caution is in order. While at the present time Tapeats Creek is an angler's paradise, the fish could not survive a large-scale invasion. Obviously a stream whose entire course can be covered on foot in a single day is fatally susceptible to overfishing. Hence it is important that bag limits be observed. The stream could be maintained as a sort of natural forcing ground where rainbows might be permitted to reach their present gigantic proportions before succumbing to a lure or a fly.

The fishing can never constitute the strongest magnet for visitors to Thunder River. In the final analysis, the country itself is the greatest attraction. The area has the earthy beauty characteristic of the mesa and canyon country—an elemental beauty compounded of red and buff-colored sandstone walls set off by the silvery sparkle of spring and creek and the rich green of streamside vegetation. Lining the streams are cottonwoods, redbud, and Arizona ash; colorful blooms such as scarlet mimulus and princess plume; and a profusion of lush green ferns. It is a scenic wonderland offering in compressed form a cross section of canyon scenery unsurpassed in the whole Grand Canyon country. Viewed in this light, it is a preserve of the first magnitude; and it should be protected as an unspoiled wilderness area that will provide adventure, exploration, and recreation for future generations.

Years may pass before the area is made accessible to the general public. The National Park Service may elect to hold it, like some of our undeveloped National Monuments, as a reserve against the day when the pressure of the country's population requires its development. Fortunately, the area is within national park boundaries, so there need be none of the prolonged conflict that invariably accompanies every effort to set aside areas of national park caliber. But the task remains to make certain that if and when this area is made more accessible, its wild, natural beauty will be kept unspoiled.

INSECT THERMOMETER

Continued from page 259

than leave it. Like the bee, it is unable to fly at temperatures below 40 degrees.

With the single exception of the malaria-bearing mosquito (*Anopheles*) I never have seen an insect flying at a temperature below 40. All noise-producing insects with which I am acquainted are mute at temperatures above 106 and below 40, some even below 65. At the lower limit of their vocality they are silenced by the cold, but above 105 degrees, though they can be quite active, they probably remain quiet because of the intense heat. All insects of my acquaintance are motionless, though not necessarily dead, at temperatures below 32.

I have observed reactions to temperature in several species of insects other than those already mentioned but have not been able to check these with a temperature recorder. Thus the ticking of that beetle popularly known as the "deathwatch" (*Anobium notatum*) in the walls of frame houses appears to vary with different temperatures. Then there is the firefly, or "lightning bug," common to our eastern states. Perhaps everyone has observed that its flashes are more rapid early in the night than later and cease entirely before morning. But in the open the firefly is continually on the wing, and when confined for observation it becomes nervous and doesn't work its flashlight regularly.

The "snapping beetle" (*Elater*, various species), which suggests the beetle-shaped "snapper" familiar to all children, snaps more frequently in warm weather than in cool, but it snaps its thorax only when held in a certain position and is affected by the warmth of one's hand.

I also have observed that the note produced by the wing vibration of many insects—for example the fly, honeybee, mosquito, and bumblebee—becomes noticeably slower as the temperature falls, but the insect itself can change the pitch when frightened or angry. Every beekeeper knows, from the pitch of its hum, whether the bee that is flying about his head is angry or merely curious. The wings of the housefly ordinarily produce a note well up the scale, but I have seen them so chilled that they could not produce the lowest audible note, which means their wing vibration was less than about sixteen per second. I also have noted that when the temperature is as low as 65 degrees, the vibrations of a grasshopper's wings are nearly slow enough to be counted, but by the time the temperature has risen to 85 degrees its wings may produce an audible note.

The field offers opportunity for some interesting but unremunerative research. I believe that if the reaction to temperature of all our common outdoor insects were well known, the farmer in his field would be able to determine the temperature with a tolerable degree of accuracy almost any hour of the day. Insects are not more sensitive to temperature changes than are warm-blooded animals, but, unlike the latter, their body temperature

Winners of the Fishes Cryptomaze in the April issue of NATURAL HISTORY: The three contestants submitting the highest number of fishes listed in the main section (A-Z) of *Webster's New International Dictionary*—1948 (unabridged), in accordance with the rules of the contest, are: HAROLD EATON, Jackson Heights, N. Y.—56 fishes; DR. HENRY S. RICH, Bronx, N. Y.—50 fishes; AL ANTHONY MANTOVI, Staten Island, N. Y.—45 fishes. Each of these winners has received an autographed copy of *North American Game Fishes* by Francesca La Monte, published by Doubleday and Company.

is practically the same as that of the air around them. Their metabolism does produce a tiny amount of heat, but it is radiated as fast as it is generated, and they can warm themselves only by exercising en masse, like the bee cluster I mentioned. Remembering how the human system is affected by a bodily temperature only two or three degrees above or below its normal 98.6 degrees, we can readily understand how profoundly an insect may be affected by a change ten times greater. When we are "chilled to the bone," medical men tell me, our internal temperature is only two or three degrees below normal.

Unlike animals, whose voices are produced by the vibration of membranes, the voices of insects are the result of muscular action, as also is the vibration of their wings, and therefore any chilling sufficient to slow down muscular movement serves to lower the pitch of both wings and voice.

The "Insect Thermometer" shown herewith is almost entirely self-explanatory. In the "Crickets' Chirps per Minute" columns, numbers in parentheses are only theoretical values, for I never have heard a cricket chirping in temperatures below 55 degrees.

The "Cricket Thermometer" pictures a little device that I once made for my own entertainment. To use it, we count the cricket's chirps for ten seconds, then bring the lower end of the pointer to the corresponding number on that cricket's scale. The upper end will then indicate the temperature of the place where the cricket happens to be. For illustration, if a black field cricket is chirping at the rate of 18 chirps in 10 seconds, we place the lower end of the index at 18 on that cricket's scale (as shown), and the upper end shows the temperature to be 65 degrees.

The third drawing is a copy of an actual two-hour record of temperature and the chirps of our friend, Mr. X. It reveals strikingly the sensitivity of that cricket to temperature changes; in fact, it surprised as well as gratified me. The chirps were counted every 5 minutes, and for

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greater accuracy were counted for 60 seconds and then multiplied by 14/60 in order to obtain the number for 14 seconds. This explains the fractional chirps indicated by the chart. Thus, for the first count, at 7:30 P.M., there were 132 chirps in one minute, which reduced to 30.8 for 14 seconds. Instead of a thermograph, a telethermoscope was used—a quite accurate instrument which measures temperature in terms of electrical resistance. On only four of the 25 counts were the chirps and the temperature record not in practical agreement. These four are indicated on the chart by short arrows. It is quite possible that the difference, which in no case amounted to more than one-fourth of a degree, was due to a slight lag-error in the instrument and to the fact that the cricket was more quickly responsive to temperature changes than was the thermal coil of the instrument—which is not remarkable when we remember that a cricket isn't one-twentieth the size of the thermal coil of a telethermoscope.

BOOKS *Continued from page 246*

of the commonest as well as one of the most widely disseminated of the wasps and has engaged the attention of a number of qualified observers.

One of the special objects of Professor Shafer's inquiry was to determine the significance of the little white pellets visible through the body wall of the wasp larva and constituting nearly five per cent of the weight of the insect when it reaches maturity. But the nature and function of these pellets are too interesting to be summarized briefly, and the reader is referred to the volume for an adequate account.

HERBERT F. SCHWARZ.

THE UNIVERSE AND DR. EINSTEIN

- - - - - - - by Lincoln Barnett

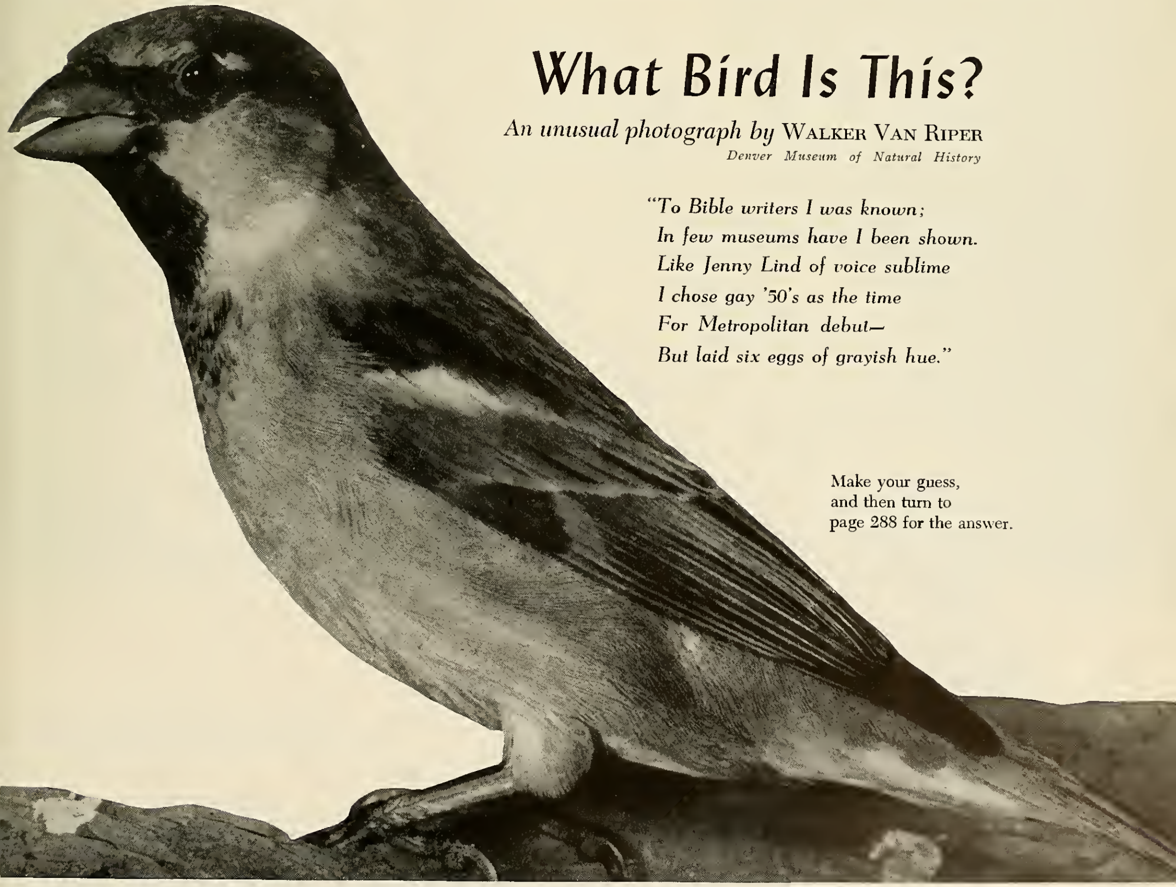
William Sloane Assoc., $2.50
127 pp., 4 illusts.

THE brief way to express a theory is to put it into mathematical form. A simple way to obscure its meaning is to write a long book about it. In *The Universe and Dr. Einstein,* Lincoln Barnett has hit a happy medium. He has neither written a long book nor has he delved too deeply into mathematical equations. This book is written for the nonmathematician whom Einstein described as "seized by a mysterious shuddering when he hears of 'four-dimensional' things, by a feeling not unlike that awakened by thoughts of the occult. . . . And yet there is no more commonplace statement than that the world in which we live is a

What Bird Is This?

An unusual photograph by WALKER VAN RIPER

Denver Museum of Natural History



"To Bible writers I was known;
In few museums have I been shown.
Like Jenny Lind of voice sublime
I chose gay '50's as the time
For Metropolitan debut—
But laid six eggs of grayish hue."

Make your guess,
and then turn to
page 288 for the answer.

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four-dimensional space-time continuum." By shaving off the obscuring whiskers of higher mathematics, the author, for the first time, has revealed the distinguishing characteristics of Einstein's theories.

Mr. Barnett, being a newspaperman, protects his reader from the icy chill most people feel when brought into immediate contact with abstract time and space relationships. He first prepares the reader with concrete demonstrations of the place that realism, as evidenced by our senses, holds with respect to abstraction, before stating that "it is the mathematical orthodoxy of the universe that enables theorists like Einstein to predict and discover natural laws simply by the solution of equations." Our senses of sight, sound, touch, taste, and smell might be compared with the abutments on a suspension bridge. Each abutment is separate and distinct from every other, but all are linked together by the roadway and supporting cables, which might be pictured as the abstract part of the relationship. Scientifically, the whole structure is tied together as a complete unit through the medium of the electromagnetic spectrum. Our senses sample various sections of this spectrum; scientific abstraction through the medium of mathematical equations fill in the balance of it. By pointing up the recognized limitations of man's senses, the role of Quantum physics and the mathematical process of interpolation and exterpolation are reduced to understandable simplicity. Thus the author lays the groundwork for this lucidly clear presentation of Einstein.

Gordon A. Atwater.

Cook and the Opening of the Pacific

- - - - - - - by J. A. Williamson

The Macmillan Company, $2.00
251 pp., 6 illusts.

The name of Captain James Cook is one of the most illustrious in the history of the exploration of the Pacific Ocean. And this is rightly so because his achievements as an explorer and navigator in this vast region are of the first rank. But aside from his Pacific exploits, Cook is hardly known at all. Like a musician in a symphony orchestra who emerges dramatically from anonymity to play his brief solo, Cook appears suddenly in English history as a seasoned and practiced navigator to play his brilliant, eventually tragic role in the South Seas.

A man of humble birth and little formal education, he became a highly skilled navigator and chart maker largely by self-education. Entering the Royal Navy at a relatively advanced age, through the unconventional avenue of an apprenticeship on coastal colliers, he made a phenomenal rise in a very short time. His selection by the Admiralty to command a scientific expedition to the Pacific in 1769 seemed a logical choice after his noteworthy surveys and charts of the Canadian coast, which occupied him for a number of years and demonstrated his exceptional skill in unknown or dangerous waters.

Cook's three expeditions to the Pacific are classics of their kind. His explorations were sound and definitive. He solved several geographical problems that had bemused European scholars for centuries. His surveys and charts were unexcelled and remained the basis of Pacific navigation for many years. His accounts of what he saw of native life and natural history remain invaluable sources for modern students.

But Cook's achievements represent a culmination of a long exploratory history of the Pacific and can be appreciated only in the light of his predecessors. The merit of this entertaining and informative book on *Cook and the Opening of the Pacific* lies precisely in the fact that this historical perspective is provided. Mr. Williamson, the author, has brought forth a noteworthy character in British history and has illuminated through the career of a distinguished man the slow advance of knowledge.

Harry L. Shapiro.

Answer to "What Bird Is This" on page 287

In 1850—the same year that Jenny Lind made her Metropolitan debut—eight pairs of this bird were brought to New York City. The birds did not thrive, and two years later more were imported. Those that survived the winter in confinement were freed in Greenwood Cemetery. They increased in the ensuing years to millions and spread over the whole country.

We called the photograph "unusual" because in fourteen years it is the first picture of the common English Sparrow that has been submitted to Natural History.

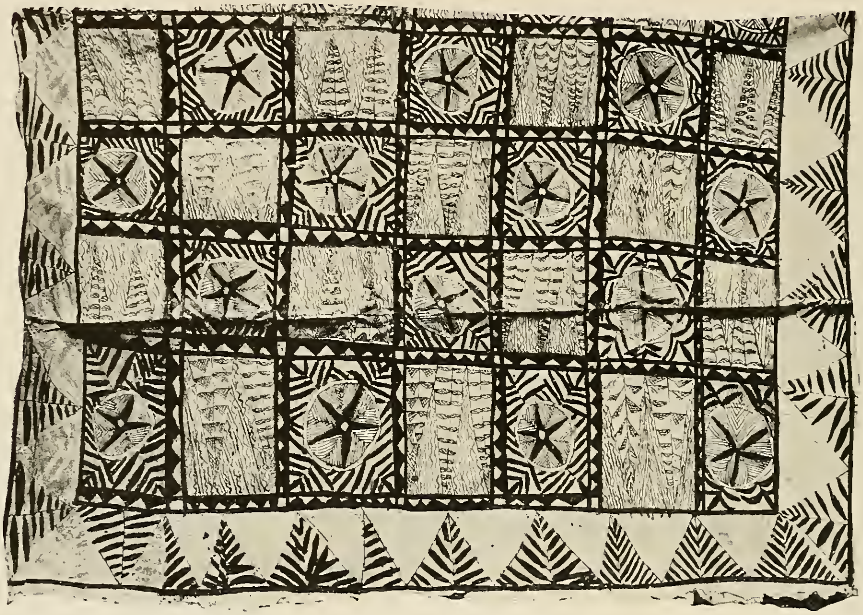
The English Sparrow is mentioned in the Bible. It lays five or six grayish-white eggs speckled with brown, and raises several broods each year. Even if there were only one brood each year, a pair of English sparrows could multiply so rapidly that in the twentieth year over *seven billion* sparrows would theoretically be hatched. Obviously, natural checks prevent this unlimited increase. In North America the English Sparrow increased very rapidly, because food was available and there were relatively few natural enemies. The population has now reached the saturation point in the available habitat. In fact, it has sharply decreased in many urban centers. Formerly, the sparrow found a plentiful supply of food in the undigested seeds in horse droppings. The advent of the automobile therefore greatly reduced the number of sparrows in cities—their favorite home.

September NATURAL HISTORY 1949

Nature's Deep Freeze • Captive Pilot Whale • Auklets

Luminous Moss • Yellowstone • Clothes Moth • Lacewing

"Decorative Items for the Home"



Tapa Cloths Hand-painted by the natives of the South Pacific. These are made from the bark of the mulberry tree, pounded into pulp under water and painted with the juice of berries. Various patterns suitable as wall hangings or tablecloths. $7.50 each 15¢ postage

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LETTERS

Moths Mating

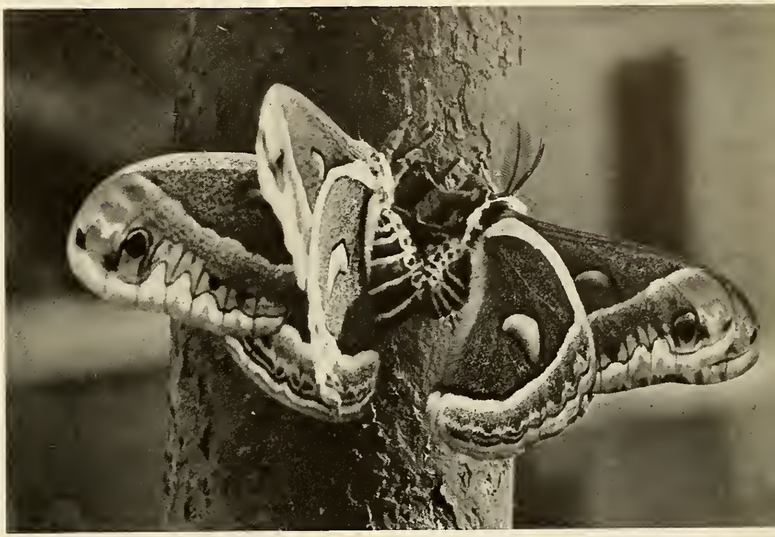
Sirs:

The accompanying photograph of a pair of Cecropia moths shows the male in the process of fertilizing the female's eggs. It is a picture I had sought to get during a long period of photographing our native plants and animals in their natural setting.

The picture was taken early in June. The female had emerged early in the day from a cocoon I had collected, and by evening I was able to move her out of doors. The following evening at about 8 p. m., she was discovered with the male, approximately ten feet from where she had been placed.

K. D. Rockwell.

Rochester, N. Y.



Earthquakes — More or Less

Sirs:

I read with great interest the article in the April issue of Natural History, "Ups and Downs of the Great Lakes," by Richard Foster Flint. It was an interesting explanation of many geographical features to be seen in the Great Lakes region, and it seems to explain the mild earthquakes that are occasionally felt in this region.

I wish to inquire whether there is reason to suppose that as the processes described in the article progress—that is, as the areas formerly covered by the ice sheet rise back up to "normal" elevation and the areas generally to the south subside and tilt back to "normal"—the earthquakes experienced in this region will tend to become more and more severe, approaching in severity those experienced in the Pacific Coast region. It would seem that the readjustments to be made in the latter region are so much greater in magnitude than those for the Great Lakes region, since the mountainous elevations involved are so vastly greater, that such a development would be unlikely. Nevertheless, I would greatly appreciate an opinion on the point.

George R. Metcalf.

Erie, Pa.

The following comments are offered by L. Don Leet, Seismologist of the Harvard University Seismograph Station, to whom the author of the article defers for an opinion:

Reader George R. Metcalf has raised an interesting point. There are several lines of evidence, both from observation and from theoretical considerations, that make it highly improbable that there will be any increase in the number or severity of earthquakes caused by crustal readjustments following unloading of the ice, even if we were prepared to admit that all earthquakes in the previously glaciated areas can be traced to that cause.

On theoretical grounds, it is practically certain that the most rapid readjustments were made at the beginning of the process and that the rate of recovery of original level decreases progressively. On the basis of historical records, the earthquake activity in northeastern North America has been cyclical rather than crescendo. At the same time, the question has been raised whether these earthquakes are really the result of crustal recovery from the ice load rather than from more fundamental, deep-seated forces, because of the striking lack of symmetry in their distribution with reference to the area covered by ice.

Inter-national Interest

Sirs:

As indication of the far-flung interest in and influence of Natural History, it occurred to me that you might be interested in the following remarks in a recent letter from my brother, Rev. Livingston Bentley, a missionary at Tabriz, Iran:

"The Natural History Magazine arrives with commendable regularity. We have grown used to irregular and unreliable mail service. Under the circumstances the delivery of Natural History has been quite satisfactory. You and the American Museum would be pleased to see what happens to it. For one thing, I took a particularly interesting copy (Paricutin Volcano, etc.) to Tehran to show to the principal and science teacher of the English-speaking school. They both declared it to be ideal for the needs of the school and said they would subscribe. This is quite an interesting school. Though it was established for missionary children, it now contains Armenians, British, Iraqi, Afghans, Indians, Dutch, Swedes, Czechs and Chinese—20-odd nationalities drawn from the families of diplomats, government advisers, businessmen, etc. Headed and taught by missionaries, it is a strong Christian influence working in an atmosphere of inter-national friendship. I have also loaned a lot of copies of Natural History to the nurses and student nurses in our hospital. When all the people who can really read them have seen them, they go to the boys in the Sunday School, who can't read English but are fascinated by the pictures. Your gift does a lot of good."

Cogswell Bentley.

Rochester, N. Y.

Needed! A Man With Vision

Sirs:

May I comment on your admirable article, "S O S for African Wildlife." The domestication of African antelopes is not an untried solution. It has long been established that the eland, our largest antelope, being a very docile animal, can easily be tamed to suit man's requirements. (See Stevenson-Hamilton "Wild Life in South Africa" and others). It only needs a man with vision and capital to carry out this experiment on a great scale. On rock paintings found by thousands all over southern Africa, the eland is often depicted in such a way that it suggests a more intimate relationship to man than that of hunter and prey, and some of our archaeologists are inclined to think that the people who produced the paintings had already domesticated the eland with success. Why should we not be able to do it again?

The Kruger National Park is not overstocked. Although it has suffered from semidrought conditions for the last seventeen years, it can still carry more animals than it does. This, at least, is the opinion of the warden, Colonel Sandenbergh, who gave me the information only three days ago. The graceful impala has been spreading rapidly through the Park and, being a destructive grazer, has indeed become something of a problem. Its chief enemy, the wild hunting dog, which was almost wiped out by a canine epizootic, is slowly coming back and may, we hope, master the impala problem soon.

I spent four days during Easter in Skukuza, on the Sabi River, and observed from the car two lions, one leopard, one cheeta, two spotted hyenas, one rusty genet, several thousand impala, a score of kudus, one sable antelope, one ostrich, fifty-two giraffes, nine hippopotami, one large herd of zebras and wildebeest, baboons and warthogs almost everywhere, a few little steenbuck, one pair of bushbuck, and sixty-three different species of birds. This along roads where the bush is often so thick that an animal standing only a few yards away cannot be seen. Considering that this wildlife paradise is only eight hours run by car from the largest town in Africa south of the equator, its value cannot be overemphasized.

Dr. W. Gilges.

Johannesburg, South Africa

America and Africa

The following note appeared in the July issue of the *Journal of the Society for the Preservation of the Fauna of the Empire*, published in England:

"Under the title 'S O S for African Wildlife,' the March number of the beautifully produced magazine of the American Museum of Natural History publishes an urgent appeal for the preservation of the fauna of the continent.

"In sending us the number in question —with a few spare copies for loan to interested members—Mr. Richard Pough, Curator of the Department of Conservation and Use of Natural Resources, writes:—'I find many people here in this country have a sincere desire to do what they can to further the conservation of Africa's fascinating mammal fauna, but it is hard to tell them what they can do. With this in mind, I should like to ask you to be sure to let me know if there ever is anything practical that Americans can do, so that I can include some mention of it in Natural History Magazine.'

"It is a difficult question to answer. Americans are alive to the fact which our own people are apt to overlook, that the preservation of the fauna of Africa is a matter concerning the whole world, and that to allow it to be destroyed is to commit a crime against mankind. But how is that view to be impressed upon those who control the destinies of the African fauna? How can Americans intervene without apparent presumption and the risk of rebuff?

"We hope that this correctly conceived approach to the question may find expression through the International Union for the Protection of Nature. But we should prefer that British Governments, central and colonial, might take this enlightened view without outside prompting.

"Probably the most useful course the Americans could take in these ultra-commercial times would be to visit Africa in their tens of thousands asking to be shown the fauna. Let the Governments concerned be convinced that there is good money to be made regularly out of living animals in their natural state and there will be good hope of a reprieve for the condemned. Perhaps, also, funds might be made available for that extensive organized research into the problems of fly-borne and infectious diseases which have so far received such niggardly support."

August 3, 1949

It's a Fish

Sirs:

In your article "Ancient Bushman Brushwork" (February, 1949), I note that some of the cave paintings found 200 miles from the sea are interpreted as representing a school of dolphins. Even a hasty glance at the picture shows that fish are represented and not dolphins (certainly not the dolphinfish).

It is virtually certain that the fish represented is one of the peculiar African family Mormyridae. The small, vertical caudal fin and the two pairs of paired fins, as well as the general body shape, support this opinion. It is difficult to make out with certainty which species is shown . . .

I presume that the painting of what was taken to be a marine animal 200 miles inland meant something to the archaeologist. Since instead the painting represents a fresh-water fish, the significance may be of a different sort. It is possible that the species represented lives only to the northward of the painting, but still in the interior . . .

Carl L. Hubbs,
Scripps Institution of Oceanography

La Jolla, Calif.

Best Chance Lost

Sirs:

Your readers might be interested to know that probably the best chance there ever was to study the breeding habits of the trumpeter swan has been lost.

Continued on page 332

Photo by A. King, from Leon

▲ A herd of elephants on the way to a watering place in South Annam, Indo-China

NATURAL HISTORY

The Magazine of the American Museum of Natural History

F. Trubee Davison, President | Wayne M. Faunce, Vice-Director In charge of Publications | Albert E. Parr, Director

VOLUME LVIII—No. 7 | **SEPTEMBER, 1949**

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You will find Natural History Magazine indexed in *Readers' Guide to Periodical Literature* in your library

THE COVER THIS MONTH

Here we see the interpretation of a traditional Indian dance by one of its foremost professional exponents, Reginald Laubin, who with Gladys Laubin recently presented a program for American Museum audiences.

This dance, the Brave Heart Dance, was transmitted to Reginald Laubin by White Eyes, an old Northern Cheyenne who has since passed away. It was customarily performed to entertain visitors. A song was sung in honor of a well-known warrior, and he, in turn, was expected to sing his "vision song" and to dance for the visitors. He was free to dance as he pleased so long as he incorporated a number of conventional and symbolic movements and followed the dance song.

Evidently Reginald Laubin caught the spirit of the Brave Heart Dance from old White Eyes, for the Pine Ridge Indians have always received his presentation enthusiastically, and the old people say he dances like "old times."

The color photograph was taken by Franz Burko, of London, England.

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YOUR NEW BOOKS

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THE VOICE OF THE COYOTE

- - - - - - - by J. Frank Dobie

Little, Brown and Co., $4.00
386 pp., numerous spot drawings

THIS book is packed with material on coyotes, both original and secondhand. The author, in addition to possessing a wide personal experience with these animals, has evidently read every available account that bears in any manner upon his subject, and he quotes extensively on the behavior of coyotes. He acknowledges his indebtedness to the works of Miss L. E. Barclay, G. B. Grinnell, J. J. Matthews, and a veritable host of others. The attractiveness of the book is greatly enhanced by Olaus Murie's inimitable drawings of coyotes and other creatures.

The main subject of the book is coyote behavior, including both factual accounts, based upon numerous reports and on firsthand observations, and coyote-lore, founded for the most part upon Indian folk tales. Stress is laid upon the animals' adaptability—including a suggestion that some coyotes may be able to reason in a primitive way from cause to effect—and upon their teamwork, their curiosity, their psychology, and their "singing." Instances are given of coyotes coming in the dead of winter to houses to be fed and of the ensuing friendships between them and their human benefactors.

A full 50 pages of the book are devoted to coyote legends. The coyote loomed large in the symbolism of the American Indian tribes, and Mr. Dobie tells tale after tale, some of them after the order of Uncle Remus and Br'er Rabbit.

The biological portion of the book is chiefly assembled in a single chapter. Dens, mating, raising pups, scent, food, hunting, the different kinds of coyotes and dog-coyote hybrids are some of the subjects considered.

It is plain that Mr. Dobie likes coyotes—at least in moderation—and that he is a true conservationist. He has no kind words for poisoning campaigns, which bring death not only to the coyotes but to innumerable other creatures of our North American fauna. Nor does he spare the latest type of "sportsman" who shoots from low-flying airplanes. His story of the "King Ranch" (p. 51) probably illustrates his own views on the subject of live and let live, or balance in Nature. The young sportsman was denied permission to shoot coyotes on the King Ranch because they were needed to "keep the jack rabbits down." When he wanted to shoot the rabbits, the answer came, ". . . we've got to have the jack rabbits to feed the coyotes."

The book is copiously documented, and there is a useful index.

G. H. H. TATE.

HANDBOOK OF FROGS AND TOADS OF THE UNITED STATES AND CANADA

- - - - - by Albert Hazen Wright
and Anna Allen Wright

Comstock Publishing Co., $6.50
640 pp., 125 plates, 37 maps

FROGS and toads are ubiquitous in the United States—even the dryer deserts and the higher mountains are likely to be inhabited by one kind or another, and there is scarcely a person in the country who is unacquainted with the "local toad." Because of its importance as a laboratory animal or as a factor in pest control, the tailless amphibian has some impact, however indirectly, on the lives of most people.

It is not inappropriate, therefore, that a 640-page book should be devoted to the frogs and toads of the United States. The Wrights seek to provide the public and the scientist with information that has been accumulating since America was first settled. Like the better modern handbooks, it includes means of identification (of eggs, tadpoles, and adults), as well as descriptions of the voice, habits, habitats, breeding, and behavior. Distributions are indicated by means of 37 maps, which include three to show life zones and rainfall in the United States.

After more than 40 years devoted to the study of approximately 60 species of American frogs, the Wrights find many problems unsolved: "In a book of this sort evidence ought to be presented with not too much youthful certainty or elderly obstinacy." Stress is laid on the necessity for studying living animals, and no one is in a better position to insist on this than the Wrights, who have personal field knowledge of virtually every species discussed. They have little patience with such dubious investigators as the chap who dug out a few ancient specimens in alcohol and then talked familiarly about the supposed frog he had heard call along the Wabash River.

There are shortcomings, of course, but scientists and the public alike will welcome the advent of a book that only "the Wrights of Cornell" could have written.

C. M. BOGERT.

GEOLOGY

- - - - - - - - - - - by H. H. Read

Home University Library, Oxford
University Press, $2.00
248 pp.

TWO years ago Dr. H. H. Read came to the United States by invitation to address the Geological Society of America, a recognition of his remarkably successful effort to interest geologists in the problem of the origin of granite and in the work that has been done by leaders in many different lands over a long period. His summation of the situation revived controversy and interest among geologists in this special field. This little popular book should be equally successful in stimulating the interest of the lay public in the subject of geology.

The book is not a textbook, as are most of the elementary geological works. It is more of an essay, rather long it is true, but more literary than statistical. For this reason, it should be well received by adults who have not taken geology in college and who do not plan to study the

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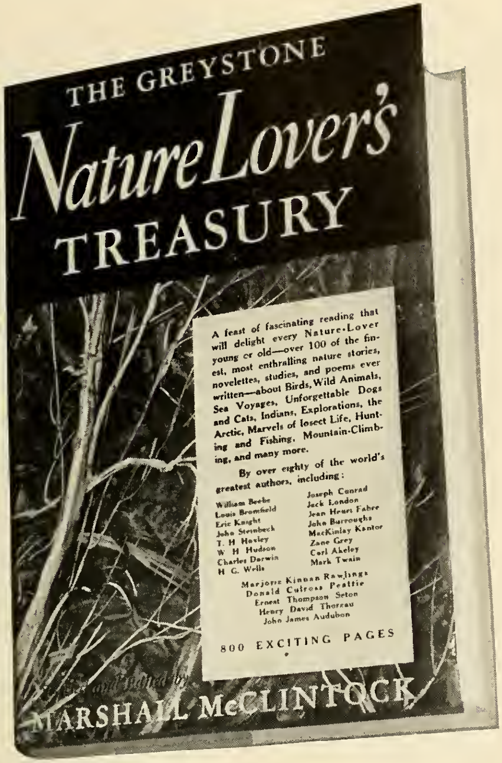

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subject. It is just good reading; and at the same time it makes clear many of the earth's features and geologic history about which any observant traveler will have wondered.

The illustrations are all diagrams and number only 30. The chapter sequence starts with sediments and the historical development of man's familiarity with his home. The igneous rocks and the inner forces enter later, along with explanations of the contortions of the crust that have made the mountains. The development of life and evolution is adequately but briefly treated near the close.

The American reader may be unfamiliar with some of the British localities that naturally come to the author's mind for illustration, but this is about the only criticism one can make of the book. Dr. Read has made an excellent job of producing a really original approach to geology for the general reader. His brief bibliography at the end suggests more technical books for those who wish to follow the subject further.

F. H. Pough.

THE VALLEY OF FLOWERS

------- by Frank S. Smythe

W. W. Norton & Co., Inc., $5.00
325 pp., 16 illusts.

THIS is a book about mountain climbing and about the fascinating flora observed and collected during a sojourn in the high Himalayas. The author is a skillful mountaineer, a good field botanist, and a person sensitive to the beauties about him. He writes well and is rather more successful in holding reader interest in the day-to-day events than is usually the case with books of this nature.

The book will make its greatest appeal to those rugged souls who can not be content to stay at the bottom of a mountain if there is any possible way to get to the top. These pages show how severe a demand the Himalayas place upon the human organism and how clever and daring a man must be to conquer them. But if the reader chances to hold the belief, ascribed to Van Dyke if memory is not at fault, that the only good reason for climbing a mountain is something very, very disagreeable at the bottom or something very attractive at the top, then this book affords the very pleasant pastime of climbing by proxy. Few of us will be tempted, after reading it, to go and do likewise.

But apart from the vicarious thrill of panting up perilous ridges, inching over treacherous slopes, or trusting to fingers and toes to keep one's self from falling off into the landscape, the reader can revel in splendid mountain scenery and the beauties of a plant association that must be vigorous indeed to endure the ice, snow, and long periods of low temperatures. Held in suspended animation for most of the year by the rigors of an environment one might well think fatal to plant life, these hardy mountaineers spring to active life when the brief cycle of sun-inspired growth arrives. As if to recompense themselves for such a dismal existence in the dark, cold earth, the plants go on an orgy of bloom, as well they must if seed is to be set and the species perpetuated. The author had a definite program to make the most of this fleet harvest period, and the flower lover will find particular enjoyment in the pages telling of the flora.

There are 16 illustrations in full color. They are striking and beautiful as a whole, but a few suffer from faulty registration and poor color rendition.

H. E. Anthony.

ALONG YELLOWSTONE AND GRAND TETON TRAILS

------- by Joyce R. and Josef Muench

Hastings House, $2.75
101 pp., 99 illusts.

REPRODUCED in sheet-fed gravure are 110 excellent reasons why the uninitiated *must* journey to western Wyoming and the answer to why those who have already visited Yellowstone and the Jackson Hole country almost always long to return. This writing-photographing team have provided a brief text by way of introduction and a series of highly artistic camera glimpses of the Mammoth Hot Springs, the geyser basins, Yellowstone Lake, the Tower Falls area, and the Grand Canyon of the Yellowstone. Interpolated is a sequence portraying the Teton range, mostly from levels easily reached by tourists. These are the peaks that "look as mountains really should," and the reviewers' only complaint is that more pictures of them were not included in this collection. The thousands who each year visit Yellowstone and the Tetons will cherish this book and let memory color the sky, the trees and rocks, the meadows full of wild flowers.

Lorus J. and Margery J. Milne.

BIRDS: A GUIDE TO THE MOST FAMILIAR AMERICAN BIRDS

------- by Herbert S. Zim and Ira N. Gabrielson
Illustrated by Gordon Irving

Simon and Schuster, $1.00
157 pp.

INTENDED for the beginner, this little pocket bird guide contains colored illustrations of 112 of the most familiar or characteristic American birds. Tiny distribution maps show the seasonal occurrence of each species in the various parts of the United States. A paragraph of text on each page gives the more important facts about the bird figured, and compares it with related species. The introductory pages tell why, where, and how to observe birds. As might be expected from the authors' background, conservation is emphasized. For the more serious student there is a discussion of bird photography, bird banding, and other worth-while activities. As a first step in field identification, the principal groups of birds are listed and characterized. Data on migration, nesting habits, and food have been gathered into lengthy tables.

From the foregoing it will be evident that the authors were guilty of no great exaggeration when they wrote: "This book is crammed with facts. The more you look, the more you will find." However, most bird students, especially experienced ones who already know many of the "facts," will be attracted chiefly by the excellent colored illustrations based upon paintings by Gordon Irving. Executed with care and skill, they reflect careful observation both of birds and of the many native plants used in the colorful backgrounds. Only occasionally does either the draftsmanship or the color reproduction invite adverse criticism. No one interested in American birds will regret spending a dollar for this book.

DEAN AMADON.

THE GREAT HORSE OMNIBUS

- Edited by Thurston Macauley

Ziff Davies Publishing Company, $5.00
462 pp., 33 illusts.

THIS collection of narratives relating to the horse have been selected from the works of no less than 67 well-known authors, with whom most readers are familiar. The point to be stressed, however, is that Mr. Thurston Macauley was able to select stories and sketches from many books that only touched upon horses *en passant*, without equine matters being their main theme. Thus it differs from most anthologies heretofore compiled for presentation to horse lovers.

The subtitle "From Homer to Hemingway" informs the reader that he will follow throughout the ages anecdotes and narratives that cannot be described otherwise than as an excellent potpourri. Nevertheless, each of the chapters has its points of interest for horsemen who, taken as a whole, seem never to tire of talking of horses or of reading what has been written about them. This applies whether the reader of this book peruses the 46 pages of "Tale of the Gypsy Horse" or only the two pages devoted to "Man O' War."

As is pointed out in the Foreword, some of the excerpts are necessarily brief in order that this work should not become unduly extended. However, this does not apply to "A Footnote to Horse Racing" by John I. Day, Jr., of the Thoroughbred Racing Association, whose 38 pages are a delight to read because of the valuable data they contain regarding the thoroughbred—past and present—in its relation to Racing as we know it today. An equally instructive Appendix gives a list of Derby winners and other statistics of interest.

This anthology is well written and beautifully illustrated, and it should receive its proper place in contemporary Horse Literature.

A. P. FACHIRI.

BIRDS IN BRITAIN

- - - - - - - - - by Frances Pitt

The Macmillan Co., $7.25
576 pp., 16 colored plates, 49 black-and-whites

IN this large volume, Miss Pitt, a nature columnist for a London paper, has attempted to present "a survey of the bird life, wild, feral, and domestic in Britain . . . with the special view of assisting the recruit to the study of ornithology." A lengthy introduction of some 90 pages considers a wide variety of topics about birds, including even such technical questions as the "formation of geographic races." The remainder of the book is devoted to informal accounts of the birds of Britain based largely upon the author's extensive ramblings in the British Isles and on the continent.

A painting of the British Goldfinch by Winifred Austen is used as a frontispiece. Sixteen other colored plates by Roland Green portray most of the better-known British birds; a number of species have been grouped on each plate. The book is further illustrated by a multitude of photographs; so many that even the author lost track of them and used the

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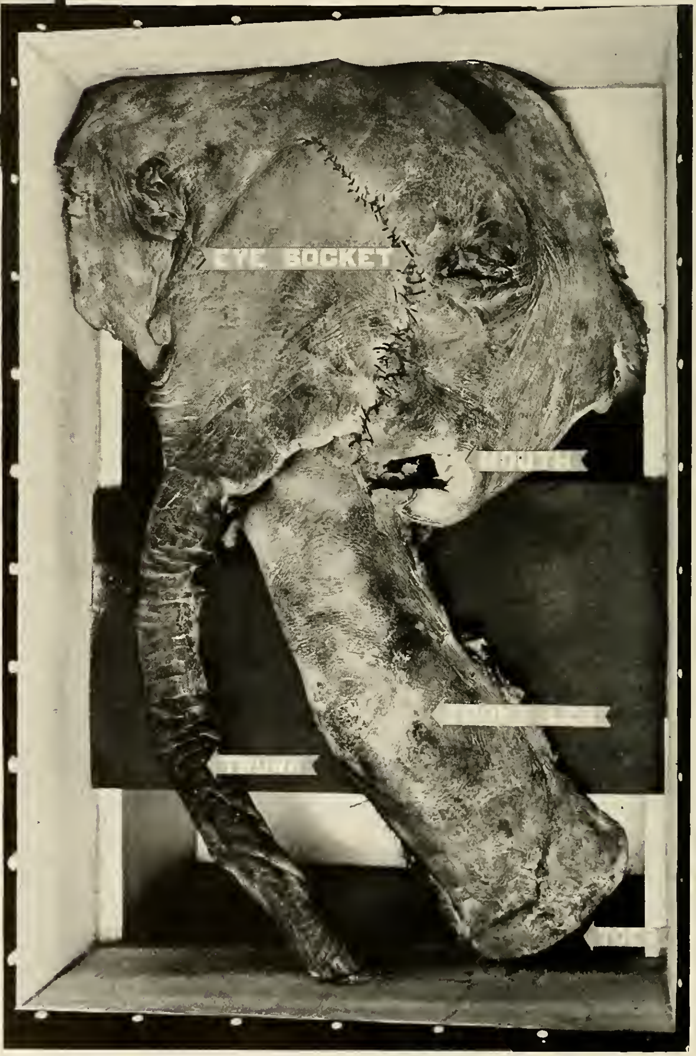
NATURE'S
DEEP FREEZE

By HAROLD E. ANTHONY

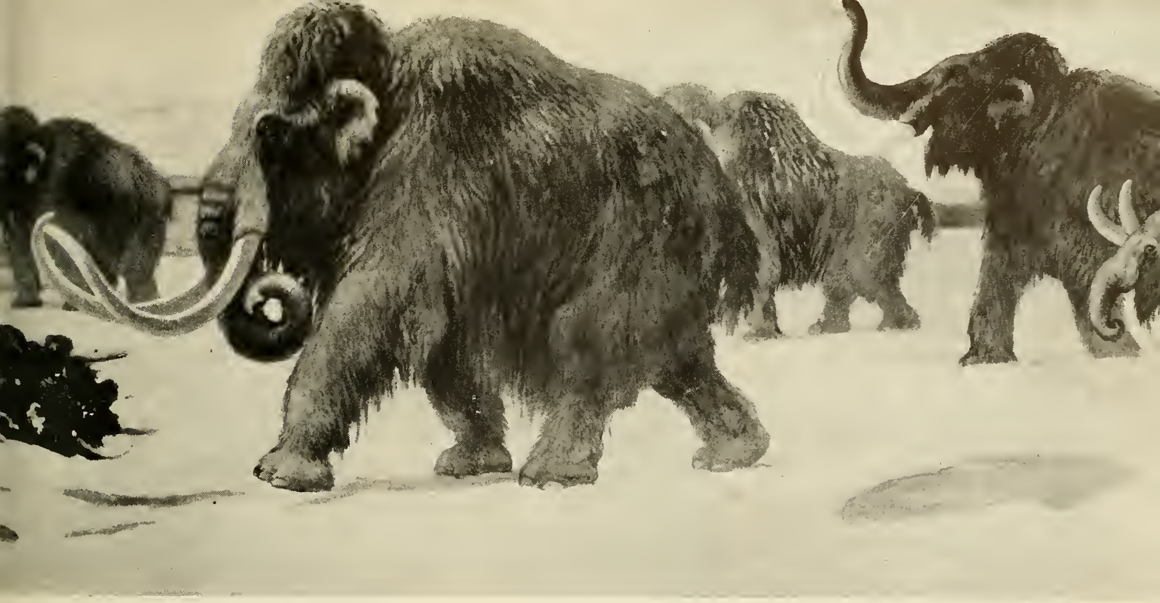
Chairman and Curator, Department of Mammals
American Museum of Natural History

BABY MAMMOTH SKIN



THE SKIN of the baby mammoth fitted snugly into a Home Freezer of eight cubic feet capacity (*above*). The skin of a five-months-old African elephant of comparable size was folded into a similar position for comparison (*lower left*). The mammoth (*right*) lacks ears and hair, lost either through damage in the long ago or by more recent events. Lumps behind eyelids may be eyes

AMNH photos



From a painting by Charles R. Knight, in the American Museum

▲ **Restorations** of the Woolly Mammoth owe their fidelity to the existence of the actual hair and flesh of this rugged denizen of long, bleak winters and brief summers

Out of the frozen past comes a brilliant discovery—part of a creature in the flesh—to evoke tangible thoughts of a distant era when the Woolly Mammoth roamed the north

THE average person finds it fascinating to speculate on the animal life of the past, particularly on those creatures that have disappeared from the face of the earth and are known today only from fossil remains. Fortunately for popular education, extensive collections of skeletal material tell us a great deal about the vanished animals of the past, and comparison of the fossils with animals living today enables the specialist to restore parts not completely preserved. But no matter how logical and convincing these restorations may be, they cannot make as dramatic an impression either on the scientist or the layman as does an ancient animal in the actual skin and flesh.

Certain special conditions must occur, of course, to check decomposition of a fallen animal and ensure its preservation more or less intact down to our own time. But discoveries of this sort have been made from time to time, and surprisingly enough, the arctic does not hold a complete monopoly on them.

In Starunia, Poland, for example, specimens of the Woolly Rhinoceros have been preserved from glacial times in a silt impregnated with salt and crude oil. Some decomposition took place before the tissues were completely embalmed, but the carcasses that have been excavated can still be regarded as animals in the flesh. The hair, which had come away from the skin, was recovered from the silt in sufficient quantity to show length, texture, and color. These fossils, therefore, give a very exact idea of how the Woolly Rhinoceros appeared when alive. No imagination is required to surround the bones with flesh and finally to clothe the animal in hair.

But nature's most effective method of preserving animal tissue for tens of thousands of years is the same as the one we use today, namely sustained low temperatures. No doubt there have been many areas where animals of the distant past have been frozen at death and given the required refrigeration to preserve them indefinitely. But in the great majority of cases, sooner or later, and usually sooner, nature's icebox has been accidentally defrosted. The carcass has then thawed and, with the passage of time, only the bones have persisted, at best. The missing parts are never seen by human eyes.

In certain regions of the far north, however, these initial refrigerations have never thawed. Summer temperatures have not been high enough or of long enough duration to melt the ice and frost more than a few inches below the earth's surface. If a frozen carcass acquired only a thin blanket of silt or ice while it lay at the surface, there was a good chance for it to survive in the flesh. In time, the covering would increase through snowfall and mud from spring floods, and eventually there would be the typical tundra blanket of grasses, mosses, and lichens to protect it further. In that event, the animal became a part of the permafrost zone, a layer of perpetual frost often some hundreds of feet thick. This zone might be called nature's deep freeze, because it is truly deep

THE HYDRAULIC OPERATIONS are a dramatic demonstration of the mass screening of a landscape, whether for fossils or gold. At Cripple Creek the "giant" strips off sun-softened muck. Huge dredges sift through the stripped gravel clear to bedrock

United States Smelting Refining & Mining Co. *Peter Maas Photo*

both in space and in time. It has been in existence perhaps hundreds of thousands of years and should persist for untold thousands into the future. The thought of what may exist in this vast icebox if only man may raid it is a most intriguing challenge to the imagination.

The fact that frozen mammals have been discovered in Siberia is well known to the average reader. Reports of these finds reached Western Europe centuries ago. Perhaps the earliest firsthand report was brought by Ides, a Dutch traveler who crossed Northern Siberia in the interval between 1692 and 1695. Peter the Great of Russia, in 1722, sent orders to Siberia to secure a mammoth in the flesh, but it was not possible to recover a complete specimen. Some of the early discoveries were of entire animals, but they were slowly exposed on river banks, and travel was slow over the vast wilderness areas in that day. As the frozen flesh thawed, it was promptly devoured by polar bears, wolves, foxes, and other carnivorous animals. In some cases, several years passed before a partially buried animal completely thawed and the last of the soft parts disappeared. This in itself indicates how favorable this northern climate is to the preservation of animal tissue by freezing.

The classical example of the Siberian discoveries is the Beresovka Mammoth found on the Beresovka River, a tributary of the Kolyma. This was apparently an entire specimen of the Woolly Mammoth when first found in August, 1900, by a native. He was led to the spot by his dog, which was attracted by the odor of what was to it edible flesh. Wolves had already been working on the carcass. Not until September, 1901, did a competent scientist reach the spot and start excavation, and some damage had been done by predatory animals and by putrefaction. It is possible to draw some interesting and rather precise deductions from the circumstances connected with this specimen.

A landslide had exposed the body, which was "sticking partially out of the ground." The carcass rested on an ice bank embedded in frozen earth, and its position was that of an animal struggling to get out of a pit. A broken foreleg and fractured pelvis indicated an accident, such as a heavy fall. This was a sudden event, for there was half-chewed food in the mouth. Very likely the fall brought a shower of earth with it, which smothered the mammoth at once. The time of the accident was late summer or early fall, because the grasses in the stomach had seeds on them.

The Beresovka Mammoth was carefully removed, skinned, and sectioned to permit transport, and finally reached St. Petersburg. It was mounted and placed in the museum of the St. Petersburg Academy of Science, posed in the attitude in which it had been found, struggling to extricate itself.

Fossil remains of the Woolly Mammoth have been reported from Alaska over a period exceeding a century. The explorer Otto von Kotzebue, on his voyage of discovery in 1815-18, wrote of the quantity of mammoth's teeth and bones exposed to view by melting ice. Since that time numerous finds have been made of bones, teeth, and huge curved tusks. But discoveries of mammoth remains in the flesh are meager, as far as Alaska is concerned. The record for arctic America does not approach that for Siberia. In 1929, Tolmachoff reported no less than 34 frozen mammoth carcasses known to him. It is possible, however, that Alaska's score may rise in future years.

There is sufficient evidence to show that the mammoth was not uncommon among the animals of Alaska in Pleistocene times.

The most productive areas may prove to be the regions north of the Arctic Circle, as has been the case in Siberia. But modern methods of mining have greatly accelerated exposures in the region of Fairbanks, Alaska. These operations are opening up formations that might have remained unexplored for decades if left to the normal climatic forces. The Fairbanks Exploration Company, a subsidiary of the United States Smelting, Refining and Mining Company, has been operating hydraulic dredges there for several decades. The gold-bearing gravels lie beneath a stratum of muck, which must be thawed and washed out of the way. This operation at any one place may require a year or more. Acres and acres of surface are systematically exposed, and this is going on in a number of sites. The turnover of muck is proceeding on a vast scale.

In 1929, arrangements were made by the Frick Laboratory of the American Museum with President Charles E. Bunnell of the University of Alaska to single out and salvage desirable material uncovered in these stripping operations. The hearty co-operation of the Fairbanks Exploration Company made this a very successful venture from the start. The great interest shown by these organizations has resulted in the accumulation of a very large collection of bones of various animals and an occasional specimen with skin and hair attached. Mr. Roy B. Earling, in charge of the Alaskan operations, and the members of his working force are continually on the watch as new surfaces are exposed.

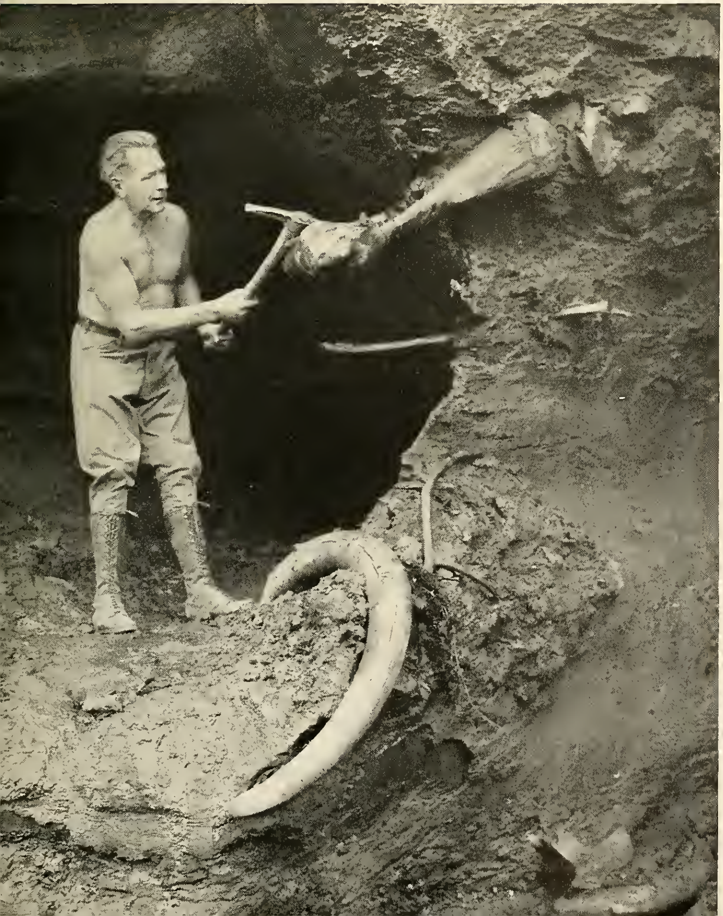
The first Museum expedition went to Fairbanks in 1929, and the field work was under the direction of Mr. Peter Kaisen, an experienced veteran in field practice. In later years, the collecting has gone on without the necessity of sending parties from the Museum. Mr. Otto W. Geist, a resident of Fairbanks, has been the active collector working in conjunction with Messrs. Bunnell and Earling, and conditions are favorable to make the most of whatever is uncovered.

Perhaps the first Woolly Mammoth "in the flesh" to be recorded from Alaska is one that L. S. Quackenbush examined on his expedition of 1907. This specimen was found in a bank near Elephant Point, Eschscholtz Bay, and by the time excavation was completed, not much of the softer tissues remained. Pieces of soft flesh, tendons, some skin and hair, and finally the "end of the tail encased in skin and hair" are mentioned in his report. This latter item seems a fitting souvenir of a vanishing mammal, but it does not tell us much of the part that vanished.

Now the latest find to qualify as mammoth in the flesh really brings us face to face with the animal. This specimen is the skin covering the face and one forelimb and also the trunk. The animal was a baby in its first year and was washed out of the muck on Fairbanks Creek, August 28, 1948, by the Fairbanks Exploration Company. By coincidence, a baby African elephant, said to be about five months old, recently flown to New York, died before it could be conditioned to a zoo existence and was presented to the American Museum by the Trefflich Bird and Animal

▼ **Peter Maas** sets about removing the limb bone of a mammoth exposed in the muck of Goldstream Creek. Durable specimens can survive washing from a bank, but anything fragile is menaced by the high-pressure stream

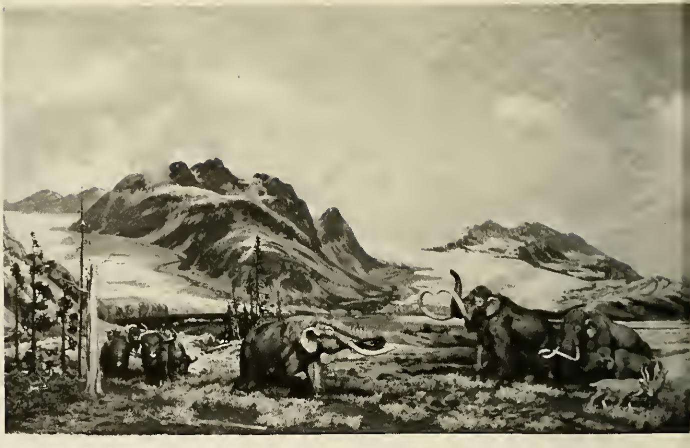
Peter Maas Photo



MAMMOTH TUSKS

AMNH photos

▲ **Tusks.** The Fairbanks area must once have been the home of many mammoths



▲ **Vanished creatures** that once roamed the Alaskan scene: a small-scale model showing how much was lost to us at the close of the Ice Age

Company. The distance from eye to eye in the baby elephant is nine and one-half inches, as compared with ten inches for the baby mammoth. The undernourished elephant weighed 169 pounds; a fair guess for the mammoth would be 200 pounds. The mammoth is more nearly related to the Indian than the African elephant, but for a gross comparison the African animal is sufficiently close.

This mammoth skin had some flesh and connective tissue adhering to it, but the skull and limb bones had dropped away. The water that washes the muck after it is thawed by the sun is under high pressure. If the specimen as it reposed in the bank was anything more than the blanket of skin and trunk, the jet of water scattered any other parts before the unique character of the material was known. The water is loaded with black mud after the stream washes into the muck, and objects in the runoff are difficult to detect.

The skin and trunk were embalmed, sent by air express to the American Museum, and stored in a cool place. On June 14, the special exhibit featuring this material and a few other samples of Alaska's Pleistocene fauna was opened to the public in the 77th Street Foyer. The baby mammoth was placed in a Home Freezer and kept at a low temperature, which simulated the condition under which it had been preserved for so many years.

How long the creature may have been preserved in nature's deep freeze is a matter of conjecture at best, but the evidence permits us to set limits within which the baby mammoth must have had its day on earth. A conservative estimate places the extinction of the Woolly Mammoth at some 15,000 years ago. But this species first appears well back in Pleistocene time, and its sojourn in Alaska is measured in the hundreds of thousand years. With the mammoth parade passing across the Alaskan stage for so many years, it is not easy to say just when one animal dropped out, particularly if it came from an undisclosed site in the muck and was discovered with other debris at the foot of the bank. Certainly thousands of years have passed since the baby mammoth lived and breathed, perhaps tens of thousands, possibly a hundred thousand years or more.

And there were many features of this time that have passed with him. The fauna then included the horse, the mastodon, a huge bear larger even than the giant Alaskan Brown Bear, a large wolf unlike any living today, a large lionlike cat, a huge-horned bison, a camel, an antelope resembling the present-day saiga of Russia, and two extinct relatives of the musk ox, not to mention species that are still living in Alaska. Prior to the discovery of the baby mammoth, the Museum had received from the Fairbanks muck the following specimens showing skin and hair: the foot of a horse, the foot of the super-bison, the foot of a young mammoth with long reddish hair, and nearly the entire carcass of an extinct musk ox. This material was dry and hard, and it would be misleading to describe it as "in the flesh." It may have been frozen in the muck at one stage, but if so, it dried out as soon as it thawed. It is not known why so many animals of this late Pleistocene and early Recent fauna became extinct. Climatic change is often evoked to account for disappearances of this sort. Considering the continent as a whole, it is true that there were marked oscillations, with mild periods alternating with cold. The ebb and flow of ice sheets, which varied from 2000 to 10,000 feet in thickness, pushed faunas and floras over wide areas during this time. But the continental ice sheet did not reach the Fairbanks region, and the published discussions on climatic rhythm in that area are not in com-

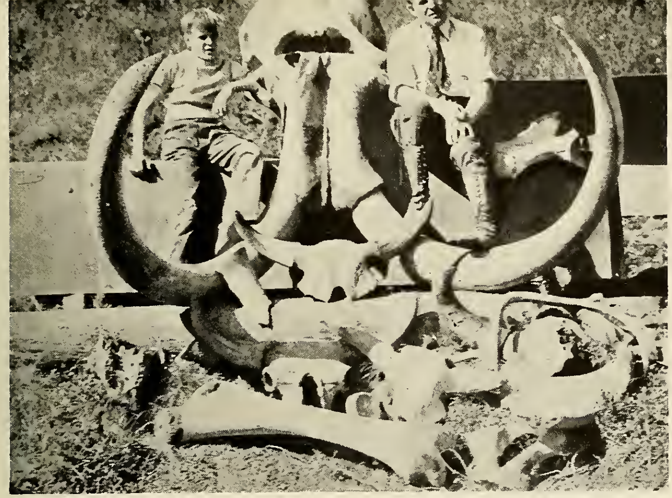


Photo by Griffins Studio, Fairbanks, Alaska

▲ THE CLEARY CREEK MAMMOTH SKULL, now in the museum of the University of Alaska, is a fine example of the finds exposed by stripping

plete agreement. Some writers conclude that the climate was much milder than at present at the time when the vanished fauna prospered, and prosper is certainly the word, as shown by the abundance of bones. Others argue that the climate during the time in question could have been pretty much as it is now, pointing out that there were plants identical with those of today.

Let us consider how a mammoth would have fared if it had been living in Alaska's present climate. It was well protected against cold by its woolly covering and long outer pelage, up to 20 inches in length. Under the skin, nature provided a layer of fat up to three inches or more. The animal fed on grasses in the short summer, pulling them up with its trunk, which terminated in two lobes capable of grasping. In winter it browsed on shrubbery, the bark and twigs of trees, and probably mosses, as does the caribou of today. Both caribou and moose survive the present Alaskan winter despite the heavy snow and the low temperatures. It seems hardly necessary to have a milder climate in order for the mammoth to exist, and a milder climate would lessen the likelihood of a carcass being frozen and held intact for thousands of years.

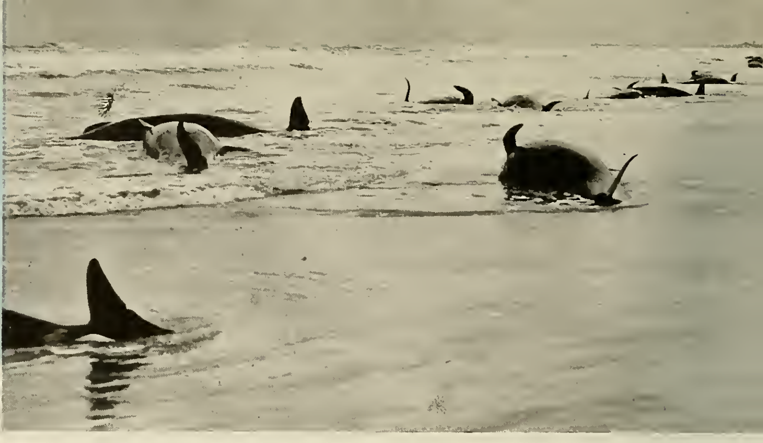
The present muck deposits in the Fairbanks region are explained by geologists as the result of a two-phase cycle. The first phase was brought about when the original Yukon drainage system was blocked by glacial ice. This caused the streams to become sluggish and lakes to form, in the bottom of which great silt beds were deposited. The second phase followed the melting of the ice barrier and perhaps some surface uplift. The stream gradient increased, and the present Yukon-Tanana drainage system was established. During this period, erosion by flowing water was rapid, and silt was washed down into the valleys to form a muck, which happily includes considerable amounts of plant and animal material and ice. There is an apparent odor of organic decay when the muck thaws today.

Especially during spring floods, organic material could be covered in these chilly deposits. It was a time when unwary creatures might easily be entrapped, especially a heavy animal like the mammoth, during spring floods. Furthermore, this shift of deposits might well include mammals entombed earlier in the original upland muck; but such a journey down a swollen river could hardly favor the preservation intact of any frozen carcass. A specimen of this sort, thawed from a bank and tumbled downstream to a new resting place, would almost certainly lose in the process.

Under a climate similar to the present, the heavy mammoth might bog down and be buried during spring freshets. Or it might break through thin ice into a pit in the muck, or die in the winter and become so covered by snow, ice, or spring mud that the initial freezing never relaxed. A landslide along the bank of a stream at the spring breakup would cover it and put it in the zone of permafrost.

Primitive man was contemporaneous with the mammoth in Europe. He drew pictures of the animal on cave walls. No doubt man was co-existent with the mammoth in Alaska. But we have far less evidence of early man than we do of the mammals among which he lived. This scarcity of human remains may be due to a higher degree of intelligence: man avoided the dangers that destroyed and preserved stupid mammals. Or man's methods of disposing of his own dead may have been a factor. Perhaps he was simply not so numerous as the other animals. But in considering the latent possibilities of the frozen Fairbanks formations, one cannot overlook the chance that man himself may be included in the list of Alaska's frozen relics.

It will be interesting indeed if a human being comes from nature's deep freeze. One is tempted to predict that his appearance would be in keeping with the times and with the Woolly Mammoth—in short, that he should surely be a man with hair on his chest. But the Mongoloid peoples who inhabit most of the arctic regions today are not nearly so hairy as the Caucasians of the temperate zone, and we may be fairly sure that even at that distant date, man in the far north lived more by his wits than by his natural protection from the elements. His intelligence probably made him a match for the towering mammoth. And if brains and brawn ever came to a deadlock, we might even someday find both together, in a double knockout.



➤ PANIC must have played an important part in driving the animals ashore. They lay helter-skelter, exhausted by efforts to reach deeper water

▼ WHEN two had been placed in the truck, they were liberally sluiced with sea water to forestall heat stroke

▼ AS PROMPTLY AS POSSIBLE, they were lowered into the oceanarium. Both swam well, but only one survived longer than eight days

THE PILO

When 46 pilot whales were driven by some unknown terror upon a Florida beach, one was successfully transferred to the famous oceanarium. Hundreds of visitors have been entertained by his interesting behavior, and he has given scientists an opportunity to study him at close range

By HENRY KRITZLER

Associate Curator, Marine Studios

Photographs by JAMES J. BOWE, *Marine Studios*

THE stranding of the pilot and false killer whales is an event that occurs not infrequently on ocean shores in many parts of the world. Indeed, the natives of the Faroe and Orkney Islands make sure of a winter food supply by driving schools of pilot whales into shallow waters, where they are dispatched easily. But, for causes unrelated to human activity, these cetaceans, which share with several other species the common name "blackfish," may run aground almost anywhere. Such landings take place periodically on the coast of southeastern United States.

Apparently no one witnessed the stranding of some 46 pilot whales on the beach about 8 miles north of Marineland, Florida, on October 7, 1948. They must have come ashore during the early morning hours, because when they were discovered at about 7:30 in the morning, the tide was almost at the ebb. Most of them were lying quietly just above the low-water mark, exhausted by vain attempts to return to deeper water. The writer, probably the second person to reach the scene, found them at about 8:00 o'clock, when the tide was just beginning to turn.

The distribution of the whales on the beach gave every indication that panic must have played an important part in driving the animals ashore. They were scattered helter-skelter over approximately a mile of the beach. There were two main groups at the extremes, with a few individuals scattered in between. One large bull, stranded below the low-water mark, had already expired, but all the rest were still living. The surf was moderate, the sky overcast. There had been no storm, so the stranding could not be attributed to inclement weather, which occasionally drives individual whales of various species ashore. It was thought that the one bull had drowned, having grounded in water too shallow to permit him to right himself and yet deep enough to cover his blowhole. On

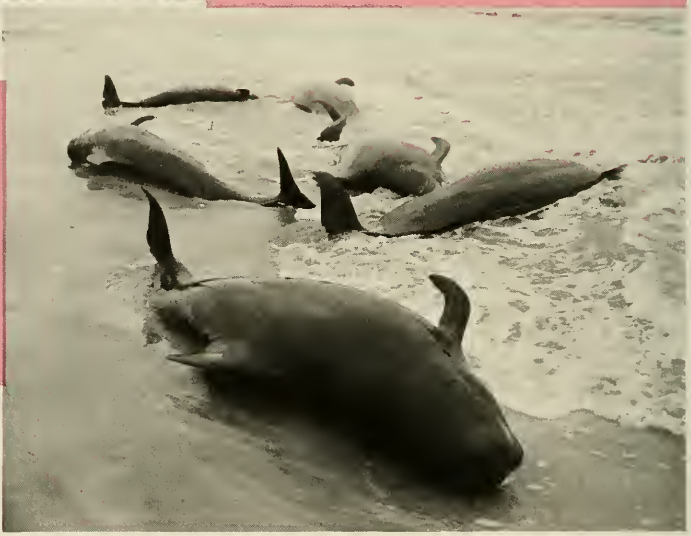
WHALE AT MARINELAND

none of the whales could we see any of the abrasions usually found on the bodies of helpless cetaceans tumbled ashore by heavy surf. They had clearly beached under their own power.

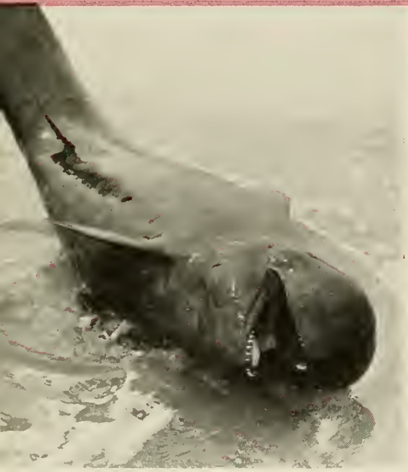
At the time of my arrival, they were all lying quite still. The silence was broken only by the sound of the surf as the tide turned and by the breathing of the whales. However quietly they lay, they were definitely not asleep, as could be seen in the active movement of their free eyes. All were lying on their sides, the shape of their bodies rendering any other position impossible. It was interesting to note how sensitive their skins were. The slightest touch immediately evoked closure of the free eye. This sensitivity has since been borne out by the behavior of a pilot whale recently kept at Marine Studios. This specimen, a male, was the smallest of the group, measuring about seven and one-half feet in length. The largest, also a male, was just under twenty feet long. The sexes were nearly evenly divided, and none of the females (some of which were as much as fifteen feet in length) was in milk. This supports the

◄ **WITH THE NEXT TIDE,** most of the pilot whales remaining on the beach were soon awash. But their efforts to reach deeper water only worked them into the sand

➤ **THE LARGEST,** a male, was almost 20 feet long. The biggest females measured about 15 feet



▼ **THE MOUTH** forms quite a cavern, for the snout is short and the head wide. The pilot whale is more tadpole-shaped than its cousins, the dolphins



theory that pilot whales enter southern waters to mate, whereas calving takes place in higher latitudes.

I noted quickly that two of the animals were no larger than medium-sized dolphins and could therefore be easily handled. At the nearest telephone, I called for a truck, padding, a sling, and a number of men. While awaiting the arrival of this assistance, my companion and I shuttled back and forth, pouring water over the two to keep them from overheating. Cetaceans lack sweat glands (which would, of course, be superfluous in the sea), and being warm-blooded animals are therefore at a terrible disadvantage when removed from their native element. They cannot rid themselves of excess body heat, which accumulates rapidly. Aside from the heat produced for maintenance of the normal body temperature and by muscular exertion incident to the struggle, they obsorb heat from the sun. This rising temperature is one of the common causes of death in stranded whales.

When help arrived, the two small whales were lifted on the sling and placed side by side in the truck. They were liberally sluiced with sea water, and a tubful was taken along so they could be sprinkled en route to Marineland. There they were hoisted from the truck and released in the oceanarium. Both swam well and seemed none the worse for their experience.

I immediately returned to the scene of the stranding, accompanied by Mr. James J. Bowe, who made the photographs illustrating this account. By this time the tide had begun to mount and most of the whales were awash. As the water splashed about them with each incoming wave, those that still had enough strength threw themselves about violently in vain effort to extricate themselves. This thrashing served, in the main, only to anchor them more securely, for they sank deeper and deeper into the soft sand. They swallowed quantities of sea water and regurgitated it promptly. The inevitable drownings were witnessed as blowholes were submerged in the rising water. The huge flukes were tossed high in the air as they buffeted the beach with their tails. By noon more than half the number had expired.

We revisited the scene in midafternoon, when the tide had receded enough to permit motoring on the beach. Many of the smaller specimens had by that time been driven nearer the high-water mark. A great crowd of sight-seers was at hand, many of them anglers having their pictures taken, rod and reel in hand, seated on the prostrate carcasses. Seldom do disciples of Izaak Walton have such an opportunity to secure photographic "evidence" in support of their fish stories.

Since the two young males that had been placed in the oceanarium in the morning seemed to be doing so well, it was decided to take one or two more. So, with the aid of a number of onlookers, a ten and one-half foot female was lifted onto the truck and, in another half hour, was swimming between the two young males in the tank at Marine Studios. A fourth, a female slightly less than nine feet in length, was taken in the late afternoon. Little hope for the survival of this last specimen was entertained, because she had an enormous sunburn blister on the upper side—eloquent testimony of the more deep-seated heat stroke to which she presently succumbed.

Of the remaining whales, one, a male about twelve feet long, was hauled to a service station as a tourist attraction. In the course of the next few days, great quantities of formaldehyde were pumped into the carcass by an experienced mortician employed for the purpose. After four months, it was still entire, but it could only be called a sad caricature of the graceful creature it was in life.

During the following night all but four of the remaining whales were hauled away to a rendering works. The last four were interred where they lay by means of bulldozers, at the instigation of county authorities. So, after less than a day and a half, there remained on the beach no evidence of this interesting event.

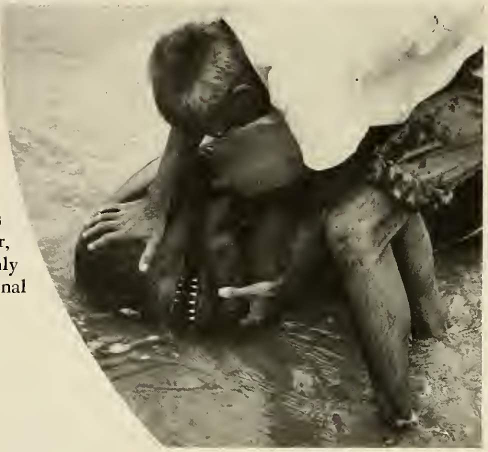
A number of theories as to the cause of the stranding have been put forth. Some press writers, perhaps with a view to exploiting the sensational, attributed it to "mass suicide," apparently unaware that lower animals do not deliberately destroy themselves. A more reasonable view is that the whales accidentally swam ashore in mad pursuit of their prey. But since I have learned firsthand that pilot whales feed preferably if not exclusively on squid, and since no squid of suitable size or numbers are to be found close along these shores, I am inclined to discount this theory. If, indeed, the pilot whales mate during their sojourn in southern waters, it is quite possible that panic broke loose as a result of competition between males. In any case, fright seems to have been involved, and, judging from the reception given the four captive whales by the bottlenose dolphins in the oceanarium, it is also possible that these smaller but more agile and aggressive cetaceans, which abound in inshore waters here, were responsible.

On a coast that descends as gradually as our Atlantic seaboard, such stranding must result in death to most if not all the victims. As indicated in the foregoing, the end comes quickly as a result of drowning or overheating. As a matter of fact, if a cetacean should get back into the sea after several hours' exposure to the sun, it is quite likely that it will expire anyway. Some authorities, in recent press releases, have indicated that the pilot whales would probably die of suffocation due to collapse of the lungs under the animals' own weight. While this may be likely in the case of larger whalebone whales, in which the rib cage is much reduced, the thoracic skeleton of the dolphins is quite adequate to permit fairly normal breathing when stranded. Porpoises captured far off shore show no distress when carried to Marine Studios on the deck of the collecting boat, as long as their hides are kept moist. The pilot

▲ A NINE-FOOT FEMALE was hoisted into the truck on a second trip, but she did not survive the effects of exposure on the beach

➤ SPECIAL TACKLE for moving large fishes and marine mammals into the oceanarium is part of the routine equipment at Marine Studios

◄ WHEN THE OPPORTUNITY was taken to measure the stranded pilot whales, it was interesting to note how sensitive their skin was. Whenever it was touched, they closed their free eye



➤ THE YOUNG PILOT WHALE apparently loses some of its teeth through wear, and the adult has only five or six functional pairs in each jaw

whale is just a large porpoise or dolphin and has a very similar skeleton.

The Fate of the Four Captives

It was inevitable that anyone who had the opportunity to observe these animals in the oceanarium over a period of time should compare them with the smaller dolphins. Indeed, the pilot whale is classified as a member of the dolphin family; but certain differences were immediately apparent. The pilot whales have far less of the sleekness and tapered streamlining that characterize the dolphins. They are more tadpole-shaped, the head and trunk being heavier and more definitely united. The eyes are set at the widest part of the body, in compensation for the fact that they cannot turn the head up and down and from side to side as do the dolphins. The eyes are also set at such an angle that, without rolling over, the pilot whale is unable to see beneath itself. The snout is short and, especially in older males, is overhung by an enlargement that appears to be a less complicated counterpart of the spermaceti organ in the sperm whale.* The shortness of the snout and the width of the head make for a relatively enormous gape when the mouth is open. Yet the jaw angle is quite narrow; fully two-thirds of the gape is taken up by great fleshy jowls. In contrast to the great number of teeth in the dolphin, adult pilot whales have no more than five or six pairs of functional teeth in either jaw. Younger ones have as many as eight or nine, but apparently several are lost by wear as they grow older. Once the animal has caught something with its teeth, which are limited to the front of the mouth, it handles it chiefly with its efficient tongue and jowls.

The pilot whale's flippers are quite attenuated, with a pronounced bend at the "knuckle," and are rather less movable than those of the dolphin. Like the dorsal fin, they serve principally as stabilizers, but to some extent they are used as rudders as well. The tail is quite long and, particularly in the males, very much compressed laterally. The effect is much accentuated in old bulls by a pronounced crest on the upper edge. This crest makes identification of sex quite easy at a considerable distance. Other outstanding characteristics of the older males are the very high, hooked dorsal fin and a hump rising to the base of the fin from just aft of the blowhole. The spermaceti organ of the bull is particularly broad. In fact, whereas in the sperm whales the principal axis of the spermaceti organ viewed from the front is vertical, it is horizontal in the adult male pilot whale, producing a very different appearance. Young male pilot whales resemble the females in that they lack the hump and have shallower abdomens than the older males, but they do show the beginnings of the caudal crest. The spermaceti organ does not begin to protrude beyond the tip of the snout in young males until well after weaning. The blowhole is of the semicircular dolphin type, but its leftward displacement is very much more obvious.

In bright light the iris of the eye narrows down to a horizontal slit, but in dim light it is almost circular. This, coupled with the jet black color of the hide, broken only by a gray kedge-shaped mark on the breast, suggests that the pilot whale is primarily nocturnal. The activity of the captive whales supported this conclusion. In every respect, therefore, the anatomy of the pilot whale, as compared with the dolphin, seems to adapt it to the nocturnal pursuit of prey that is capable of some speed but not of quick turns. And the squid seems to meet these requirements. The dolphin, which feeds to a considerable extent on fishes, must be and is able to execute intricate maneuvers, which have not been observed in the more rigid and inflexible pilot whale.

The four whales exhibited a gregariousness not at all surprising in a species so strongly characterized by the herding instinct. They re-

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* Dissection has revealed that the pilot whale's spermaceti organ, like the narwhale's, is less specialized than that of the sperm whale. It is a pad of oil-filled connective tissue, which not only serves to buoy and cushion the head but also is intimately connected with closing the nasal passages when the whale dives.

▲ IN THE OCEANARIUM, the pilot whales kept so close together much of the time that their bodies touched

▲ NIGHTLY FEEDINGS accustomed the nocturnal pilot whale to the feeding platform. Visitors were entertained by the obvious pleasure he derived from being patted on his bulbous snout

▼ SOON AT EASE in their surroundings the pilot whales were not afraid of the diver with his food basket. They did not molest the smaller fishes in the tank but preferred squid, shipped to Marine Studios with some difficulty

mained together almost all the time, their bodies generally touching. They stayed at or near the surface almost continuously, only the smallest making shallow dives from time to time. It has long since been realized that pilot whales habitually rest in this position—with blowholes and the back and dorsal fin above the water surface, the rest below. The function of the spermaceti organ as a buoy is at once apparent. When the animal was resting, it used the flukes only enough to oppose the current in the tank.

The last one to be brought in—the one that was sunburned—failed rapidly, its tail dragging at steeper and steeper angles as it lost strength. None of the whales showed the slightest interest in the food fishes (blue runners and mullet) offered them or in the small porgies and grunts exhibited in the same tank. All had difficulty opening the eye that had been in contact with the beach.

The porpoises, which adopt a distrustful attitude toward any newcomer in the tank, even if it be a

MARINE STUDIOS

newly-born porpoise, clearly resented the presence of the whales. At first, this animosity was made manifest only by the jaw-clapping with which male porpoises threaten one another. But on the third night, there was open hostility. A night attendant watched helplessly while the porpoises rammed and bit the whales. The whales were entirely on the defensive and sought only to avoid the attacks. One of the whales was pretty badly scratched, but the only serious outcome was the death of an infant male porpoise, born in the oceanarium less than six months previously. During the fight it was noted that when pressed, the pilot whale was capable of as much speed as either of the two species of dolphins exhibited in the tank. The fight lasted about an hour and a half, and no further incidents of the sort occurred.

Three of the pilot whales died within eight days after capture. The first one to go was the badly sunburned female. It survived scarcely 48 hours. At autopsy, the congested condition of the cerebral blood vessels confirmed the diagnosis of heat stroke. The second female died after seven days in captivity, and in this specimen as well, the post-mortem examination revealed signs of heat exhaustion. Porpoises have been known to live two weeks after suffering irreparable damage due to overheating. The third whale, one of the young males, died on the eighth day. A futile attempt to force-feed it with fishes and crabs was made on the day before. Handling necessitated by this maneuver probably hastened its end. All the while, we were making frantic attempts to secure squid, since it was apparent that the pilot whales would take no fish. A small amount of squid was received on the ninth day, and during the earlier hours of the following morning the last survivor had his first meal since before stranding.

The Story of the Last Survivor

During the first two weeks after he began feeding, the only surviving whale was restricted to a ration of 20 pounds of squid a day. When an adequate supply—a whole carload, as a matter of fact—was secured, the ration was increased little by little until he was eating 40 pounds a day. Growth, which is extraordinarily rapid in cetaceans, was apparent in a short time. After 4 months it was estimated that he had put on from 100 to 200 pounds. He was quite fat and had developed a prominent paunch. He had increased in length about a foot.

At first, the squid had to be tossed to him as he swam about the tank. If they fell into the water directly ahead of him, he was apt not to see them and occasionally swam right over them. The spermaceti organ made it impossible for him to see anything within eighteen inches directly ahead. So the attendants soon learned to drop the food a little to one side and near enough to enable him to swerve and grasp it before it was snatched up by the more active fishes and dolphins. When the long-snouted dolphins were thus able to steal a squid, they quickly swallowed the morsel, but the bottlenose dolphins wanted only to play with it. They would toss it into the air again and again, eventually letting one of the numerous sheepshead or triggerfish make off with the battered remains. When the whale became more active and aware of the consequences of this competition, he learned to throw his weight about in order to drive the fishes and turtles away.

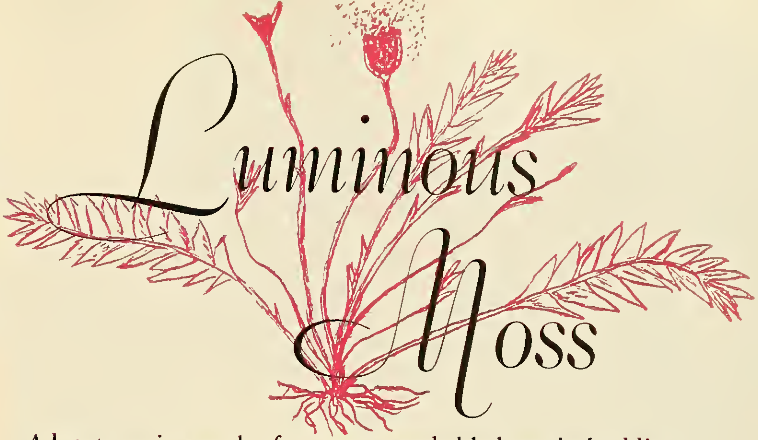
Three whale feedings were scheduled for each 24 hours—in midmorning, midafternoon, and the early hours after midnight. It was during the night feeding that he was gradually conditioned to being fed from a small platform jutting over the water at the edge of the tank. In this stage of his training he would cruise about in tight circles, taking a single squid each time he passed the platform. The dolphins, turtles, and fishes also learned to come to the platform and for a while constituted something of a nuisance. It was found that the dolphins could be frightened away merely by waving a pole over the water; but the turtles, exhibiting the mental sluggishness that always overtakes animals whose bodies are encased in stout armor, had literally to be shoved aside to enable the timid pilot whale to come in and get his meal. Presently, however, the youngster began to be aware of his own powers of strength and to share in the task of dispersing the rabble by ramming them with his spermaceti organ or by biting.

This phase of feeding soon gave way to a new, more satisfactory method. He eliminated the circling about and merely stayed alongside the platform, tail down, snout and jaws out, as the squid were placed, one by one, between his teeth. It was not until this was accomplished that the attendants were able to feed him fish. Since he had spurned blue runners and mullet when these were offered, 100 pounds or so of cold-storage herring were ordered from New England. The whale gave every indication of surprise when he found herring instead of squid in his mouth, but he downed them. He did not seem to digest the fish as well, but this may have been due to overfeeding. Herring constituted somewhat more solid fare than the soft, boneless cephalopods. So the diet of squid alone was renewed, and he thrived on it.

When feeding time came and the attendant approached the platform with the pail of squid, the whale usually arrived first. He moved away from arm's reach only to butt turtles out of the way, and it was evident that he derived pleasure from being patted on his bulbous spermaceti organ between morsels. When the pail was washed out, the whale glided away, already aware that this act signalized the end of the meal. He usually spent the next hour or so napping at the surface, in the characteristic sleeping position described earlier.

During the first two or three months of captivity, the whale slept chiefly at night, for periods of as much as two hours at a time. There was too much activity and noise in the oceanarium during the day. When he adjusted better to his surroundings, he could be seen

Continued on page 331



Luminous Moss

Adventures in search of a most remarkable botanical oddity

By Ellen Emeline Webster

It may flash like emerald gold one minute, then, as quickly, dim into invisibility. How could anything so entrancingly beautiful be scarcely mentioned in books on mosses? It is so little known that my first view of it brought the thrills of original discovery.

My path in search of this remarkable plant has bristled with interrogation and exclamation points. It was late in September when my lifelong friend, Miss Mary Lamprey, sent us, her callers, in search of this rare botanical treasure. For many years she had been harboring its growth in her barn cellar on a New Hampshire hillside. The sight fairly made us catch our breath. We saw on the hard-packed, cellar-bottom soil – between barrels and piles of boards, between a wagon body and a chopping block–aisles of dazzling, sequin-flecked, green-gold carpeting! We gazed in fascinated amazement. What magic brush had surpassed all previous achievements to produce these emerald-gold surfaces!

We stooped to scrape up a spoonful of the soil to look at it more closely. Instantly all its goblin-like luminosity faded out, and there appeared just plain black dirt! Absolutely nothing to clutch but well-trodden earth! Not a sprig of moss did we see! Not a particle of lichen-like growth met our eyes!

Straightening up, we looked about. There, again, on the granite underpinning, on and under a straddling sawhorse, were splashes of glittering green. These spots were not only a bright green; they glowed as if electric lights were behind them. We could scarcely believe our eyes, still less explain the wonderful spectacle.

Days passed. Several libraries were searched without finding mention of Luminous Moss in textbooks or encyclopedias. At the New Hampshire State Library, the late Dr. A. J. Grout's *Mosses With a Hand Lens* did give the most intriguing description of *Schistostega* that has yet been written by an American. He had been impressed as we had with the peculiarities of its luminosity and with its fleeting "temperament."

After noting both Dr. Grout's eulogy and the utter neglect of other students to list Luminous Moss, my curiosity was sufficiently aroused to write the botanical departments of several colleges. All the professors responded generously.

The aggregate of facts received was most valuable. Two professors sent me the quotation I had already copied from Dr. A. J. Grout's *Mosses With a Hand Lens.* The earlier specific name of *osmundaceae* had been changed, I was told, to *pennata.* And *Schistostega pennata* had been *reported* in New Hampshire from Lost River Gorge, Franconia and Dixville Notches, and Tuckerman's Ravine, but only one of these professors had actually seen it. All colored illustrations of mosses of any kind, so far published, were very old; even the uncolored ones used by Dr. Grout were more than century-old copies (about 1836) of *Bryologia Europaea.* And an ecological study of Luminous Moss, published in 1918, had been prepared by Viscount Yasumochi Toda at the Imperial University in Tokyo. I succeeded in obtaining this from the Congressional Library at Washington, D. C., and copied it almost in its entirety.

The marvelous research of Toda thrilled me to the finger tips. But I ran into nomenclature that was as unintelligible as the "Mene, Mene, Tekel, Upharsin" that floored King Belshazzar. The bryological terms "Chromatophore, Chloroplastid, Cytoplasm, Prothallium, Pteridophyta, Protonema, Sporangium, and Archegonia" needed a Daniel for interpreter. Without attempting to pose as a Daniel and with the use of as few jaw-breaking names as possible, I give my version of the growth of Schistostega.

Although Luminous Moss, because of its oddities, is placed in a family by itself, it *is* a moss, and its development follows more or less that of all mosses. It has a stem, leaves, and roots. The anemic-looking plant, which Toda refers to as a "shoot," is about an eighth of an inch high, with sickly, bilious-green leaves. Like all mosses, it is flowerless, but at a certain season it sends up tiny stalks, each stalk bearing aloft a capsule (sporangium), which contains the spores that serve as seeds. When the spores are "ripe," the capsule opens and the spores are scattered.

After hours of concentration over various authors, the growth of a spore into a moss plant has become somewhat, though not altogether, clear to my mind. The spore is as a speck of dust that has to be magnified about 500 times to appear as large as a grain of pearl tapioca. Yet that speck is filled with a colorless sap in which are grains, or

Photograph by Elbert D. Currier

◄ "OLDFIELDS," the picturesque New Hampshire farm where Miss Mary Lamprey found the rare moss growing. Despite the unique fascination it holds for botanist and layman alike, few have ever seen it

▼ WITHIN this opening to the cellar of the barn the Luminous Moss glistens like a sequin-flecked carpeting of green gold. If you pick it up, it at once loses all its refulgence

Photograph by Dr. Charles J. Lyon

chloroplasts, that contain chlorophyll (green coloring matter) with starch, sugar, and whatnot. These pigment cells in the Luminous Moss change shape according to the amount of humidity, temperature, direction, and intensity of light.

Our spore of Luminous Moss, let us say, has found a spot that is moist without being soppy. If the atmosphere has a humidity of over 90 per cent and a temperature between 60.8 and 77 degrees F., with a dim light—too dim for other mosses to grow—the spore will, within a month's time, send out a threadlike tissue called "protonema." Each spore seems to possess a personality that grows without rhyme or reason, producing different shapes, sizes, contents, and positions. It reminds me of Ezekiel's vision in which he saw "as it were, a wheel in the middle of a wheel . . . and their rings full of eyes." To call the pigment cells "eyes" is appropriate because eyes may glitter.

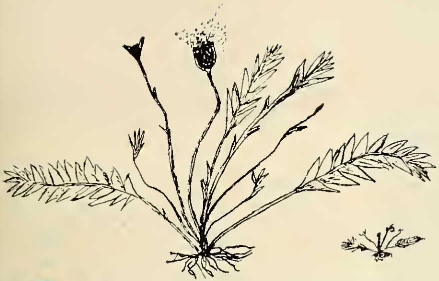
The thread, elongated from the spore, starts borning within its tube a series of cells which, like beads, may string along in a row or, like grapes, cluster into a bunch. Certain of these cells may start a real moss plant, called a "shoot"; or filamentous thread-sized tubes may be produced, or a chain of lens-shaped cells, and so on, changing direction, ramifying, but always with the specks of chloroplast suspended in the cell fluid.

This protonema is mighty important. It isn't actually the moss plant, nor can it even be called the *root* to a moss plant. It is a threadlike runner *connecting* moss plants. The dictionary defines it as "a filamentous structure developed from a spore, on which the leafy plant arises as a lateral shoot." This filamentous structure, until magnified, is finer than a strand from a spider's spinneret, but it is tougher than the moss plant proper. It excels the moss plant in its ability to withstand heat, cold, drought, flood, variation of light, and poor nutrition. The luminous plant may live at a dying rate or lie dormant for years and then revive when normal living conditions are restored. During a long drought, the plant shrivels and its cells store up oil for holding its vitality, instead of the starch that is needed in the cells of the protonema to give out the angelic light. And it is for an explanation of this light that our curiosity has been whetted into active research.

Dismiss all thought of the "shoot" with its leaves, roots, and capsule-headed stalks, for no part of them is luminous. Concentrate on the protonema and, what is more, concentrate only on its bean-shaped cells. There are spherical cells in the protonema, but they do not perform the trick of lighting up any bed of moss.

One authority has likened the bean-shaped cell that contains the pigment granules (chloroplastids) of green coloring matter to a biconvex lens having an upper and a lower wall. Split this bean cell open and its outer walls would show the curve of a parabola. The chloroplastids must be concentrated in the *basal* area of this paraboloidal wall, not scattered hit-or-miss fashion on the upper as well as the lower half. Moreover, these bean-shaped cells must lie at right angles to the ray of light that acts the part of torch. If the ray travels *along* the optical axis, it is so refracted that it hits the pigment granules, and the consequent decomposition of carbon dioxide produces a "glitter." It seems that if the source of light is moved, the chromatophores change their position in the direction of the new light in about a week.

The light enters as white light; it emerges as a luminous green. Scientists state emphatically that this is not what is known as phosphorescent light but something altogether different, yet nonetheless startling in effect. And startling is none too emphatic a word. Grass is green; many mosses are vividly green, but they do not *glow*. They do not shine and glitter like cats' eyes in the dark. You come away from a bed of Luminous Moss really hugging yourself because of the

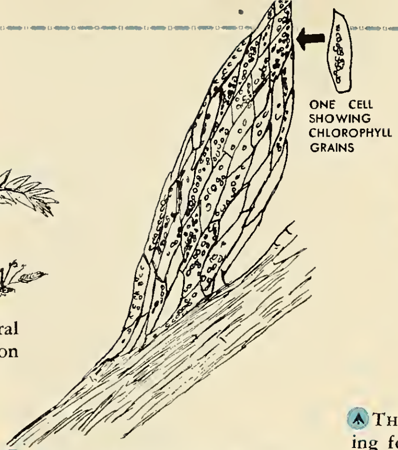


The plant enlarged and in natural size, from a drawing by Ethel Hutchinson

novel sight. As the gleaming luster from a ruby, a diamond, or an emerald attracts and holds our attention by its consummate beauty, so Schistostega, by its luminosity, must always surpass all other mosses because of its individual radiance—a radiance that comes from *reflected,* never from *direct,* light. Always, in order to see it, the observer must stand with his back to the opening that furnishes the light. Only when you are directly between the tiny parabolic reflectors and the source of light will the moss shine. But use care not to shut off *all* the source of light. Also change position to receive reflections from various angles in order to discover the complete areas of the sheets of goblin gold to be found growing in that particular cave or cellar.

Which of our American bryologists is going to write another chapter to the life story of Schistostega that will be outstanding in significance? Already three whom it was my privilege to bring in contact with one another are to be credited with beginnings: Miss Mary Lamprey, our generous hostess; Mrs. Ethel Hutchinson of Canaan, N. H., who did noteworthy research and produced slides for the microscope; and Dr. C. J. Lyon of Dartmouth College, who was the first to produce kodachromes of Schistostega.

Mrs. Hutchinson, a person of cyclonic enthusiasm, has been studying with our most eminent bryologists and collecting New Hampshire mosses for ten years but had failed in that time to find Schistostega. Learning the location of Miss Lamprey's surprisingly profuse growth of Luminous Moss, she let no moss grow on the soles of her shoes until she had visited this barn cellar several times. She stood on her head in the mud to make observations and found that the tiny mosses were in fruitage. She collected soil and plants, and, following my notes from Toda, she made transplantings and actually succeeded in starting growths of leaves and witnessing the gleam of the protonema from her own Luminous Moss, but the plants did not survive the winter.

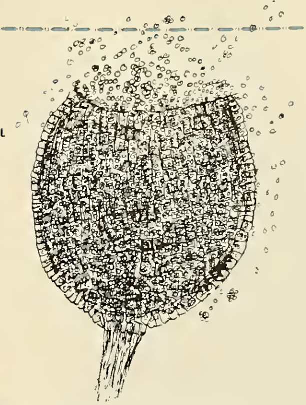

ONE CELL SHOWING CHLOROPHYLL GRAINS

One leaf and part of the stem of the Luminous Moss, enlarged many times, showing the leaf cells. Neither the leaf nor any other part of the true plant gives off the light. It comes from the protonema—the primary threadlike substance from which the plants themselves grow

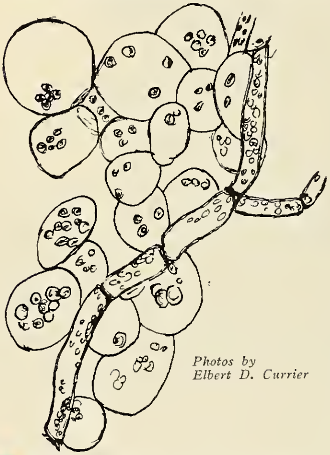
That is by no means all she has accomplished. She has separated all the different parts of the plant and made a series of slides for the microscope. She has sent a score or more packages of the moss, which she names as "the most beautiful thing of the sort in all nature," to various bryologists, and has held correspondence with members of the Sullivant Moss Society.

Five of Dr. Lyon's films with descriptive paragraphs were sent to Dr. H. S. Conard for presentation on the Chicago program of the Sullivant Moss Society in December, 1947. These bryologists considered this display truly wonderful.

Buoyed up by these thrilling developments, I determined in 1948 to be on hand when Schistostega had lighted her lamps. I was rewarded by an even greater display than that of 1947. This moss with "beaming green . . . burnished through every fiber into fitful brightness" had spread as carpeting over the length and breadth of the cellar, from within a foot of the entrance to the opposite wall; yet should you carry a handful of the scintillating soil, an illuminated foundation stone, or a glowing board into the bright sunlight for a studied view, not a vestige of a glimmer would reward your efforts! Truly a mystery plant!



The capsule with its spores bursting forth in a cloud under pressure of the cover glass on the microscope slide. This, like the other drawings, were made by Miss Hutchinson with a camera lucida from the actual slides. Magnification 440 times



Photos by Elbert D. Currier

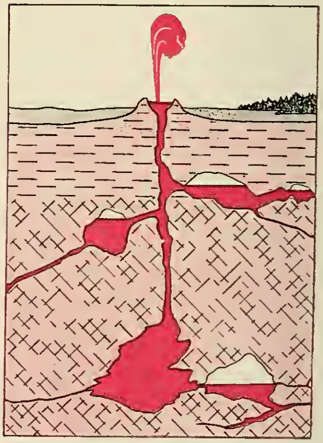
The protonema with the light-bearing cells, from a specimen mounted in glycerine and enlarged 440 times

Therma

JOHN COLTER trapped in the Yellowstone area as early as 1807, but his accounts were called impossible. And when the famous storyteller Jim Bridger began his explorations in 1830, his exaggerations further convinced people that it was a myth. Not until 1869 did expeditions begin to bring back accurate and convincing knowledge of the world's most fantastic display of thermal wonders.

The Washburn-Langford-Doan Expedition of 1870 reached the Upper Geyser Basin on a clear September day. Coming out of dense woods, the travelers were dazzled by the glorious eruption of a towering column of water and steam. With a roar, the fountain spread like a magic tree, growing lacy

▲ OLD FAITHFUL'S four-minute display every sixty-five minutes helps to draw about a million visitors to the Park each year. But there are more than 10,000 distinct hot-water features in Yellowstone, only about 500 of which have been named. In 1920, 99 per cent of the visitors reached the Park by train; 7 years later 99 per cent were arriving in their own cars.



▲ DEEP in the geyser, water under pressure from the weight of the water above produces superheated steam. Bubbles of this steam, rising in the tube, suddenly convert additional quantities of water to steam, accelerating the eruption. Steam chambers that lack outlet above the water level also doubtless play a part

◀ GROTTO GEYSER erupts every two to eight hours, but it is perhaps more famous for its cone. The colorful convolutions show how elaborate the cone of a geyser can become

Wonders of Yellowstone

Since the first rumors of "Colter's Hell" fell on incredulous ears about a century and a half ago, millions of visitors have thrilled to Yellowstone's matchless array of natural marvels

By Joyce *and* Josef Muench

branches that blossomed in the sunlight.

Since that summer, when they spoke of it as "Old Faithful, the Guardian of the Valley," this best loved of all Yellowstone's surprising features is estimated to have erupted half a million times, every 65 minutes or so, day and night and in every season.

Without its regularity, Old Faithful would not have become the symbol it is. Its rhythmic dependability is what captures people's interest and curiosity.

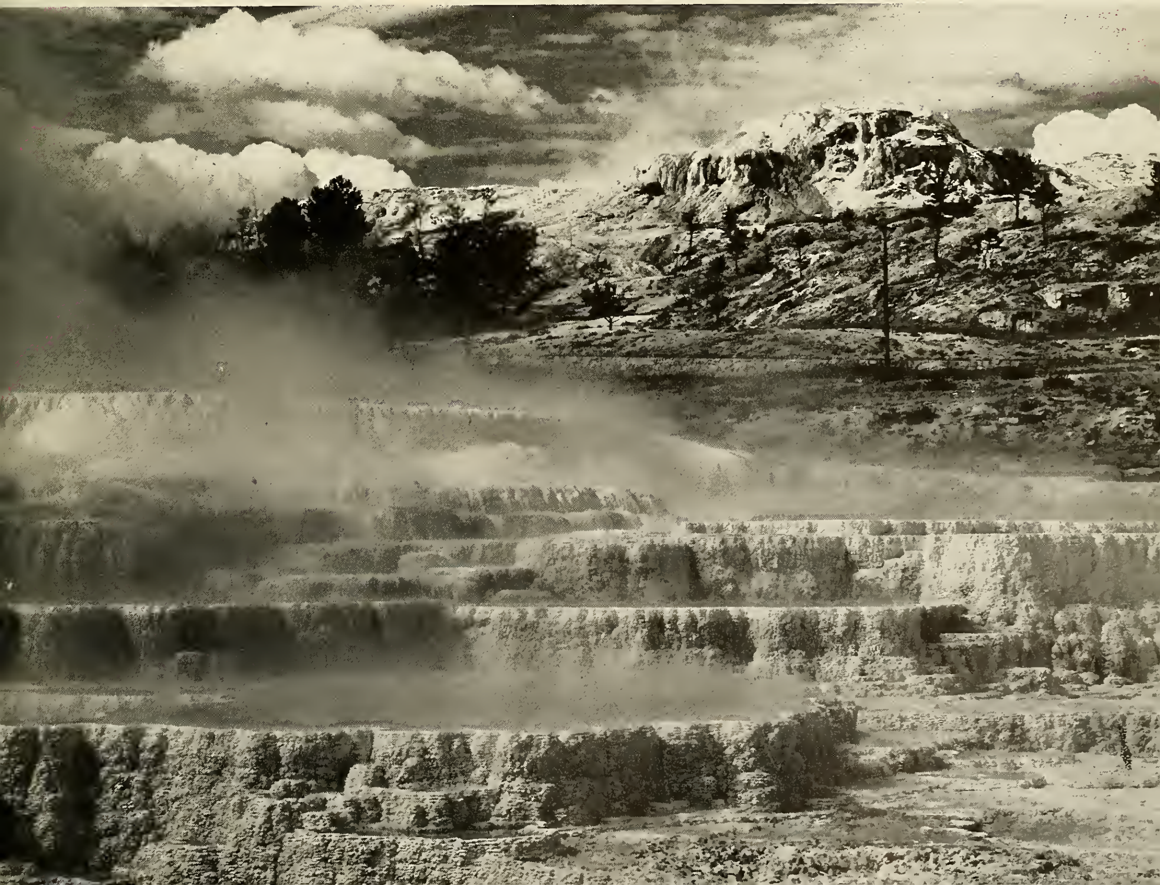
"It's almost time for Old Faithful!"

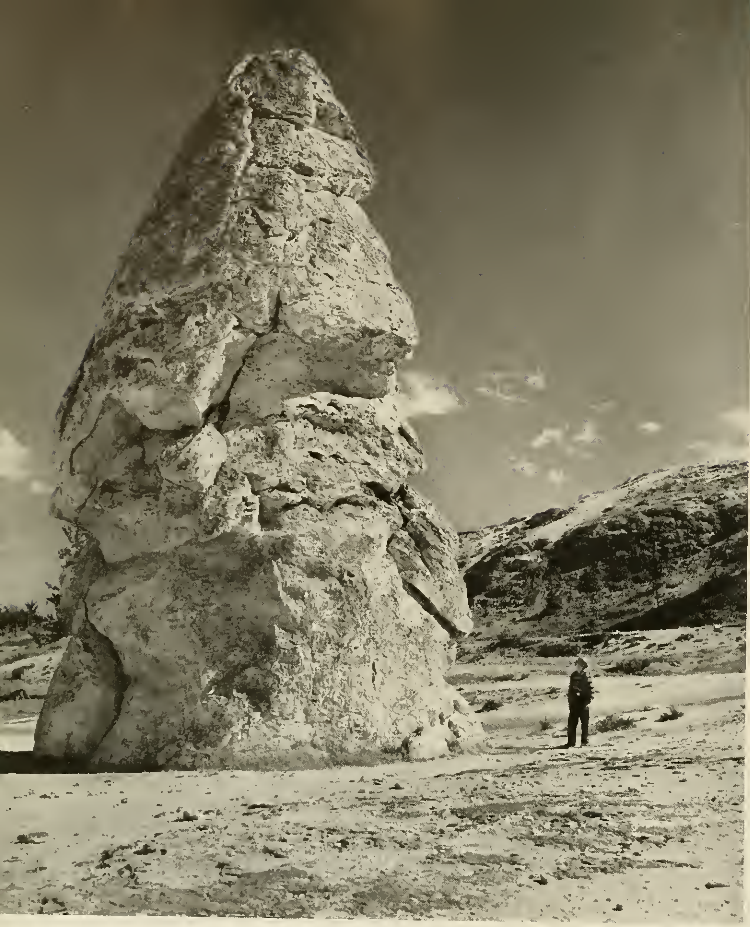
A ranger takes his position at a safe distance, and a camera appears in almost every pair of hands. There is a rumble and hissing of steam, and the tremendous roar of rising water hardly drowns out the gasps of delight that have come to be part of its performance.

Why does Old Faithful erupt at such regular intervals? The force behind the eruption is, of course, the pressure of steam. Its suddenness is due to the fact that conditions in the tube beneath the cone prevent large volumes of water from reaching the boiling point until a given moment.

Water that is under pressure will not turn into steam at the normal 212 degrees F. Greater heat is nec-

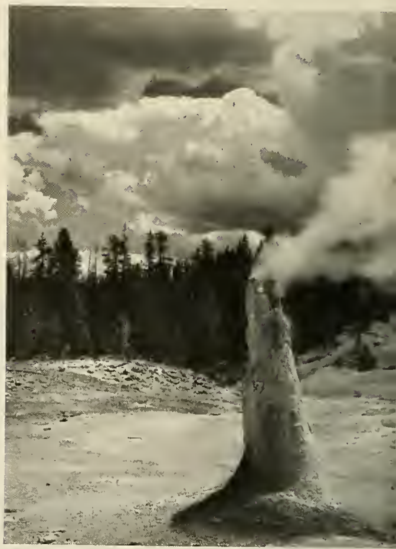
∨ Opal Terraces. One of the most rapidly depositing formations at Mammoth Hot Springs is Opal Terrace, at the foot of Capitol Hill. Its delicate form and pastel shades make it a thing of beauty





◄ **Liberty Cap** was built by a hot spring rather than a geyser. Material gradually deposited by the water formed layer upon layer of travertine, until a height of 37 feet was reached. The spring no longer flows, but a tiny plant is struggling for existence at the top

▼ **Monument Geyser** has a slender, columnar form, taller than a man. It erupts almost continuously, but most visitors never see it because its secluded valley can only be reached on foot



essary. The weight of the water in the tube of the geyser makes the pressure higher near the bottom of the tube than at the surface. It is not ordinarily possible to heat water hotter than its boiling point (212° F. at sea level); it simply boils and goes off into the air as steam. But the water deep in a geyser, being under pressure, exceeds the normal boiling point of water. The hot rocks with which it is in contact gradually raise its temperature beyond this point, and the narrowness of the tube above prevents the heat from being distributed upward to where the pressure is less. Eventually, however, the water at the bottom reaches its own boiling point, and bubbles of superheated steam are sent violently upward through the tube. Suddenly water in various parts of the tube, already near the critical point, produces steam. Water is forced violently out at the top, and this further reduces the weight of the column. Conditions thus combine to hasten the conversion of large quantities of water into steam, and the geyser "blows its top."

It seems likely that steam chambers like those shown in the diagram on page 312 also contribute to the sudden violence with which this and other geysers erupt. If steam is quickly generated in such a chamber and cannot escape without forcing a quantity of water out, a fairly long eruption might result from a relatively small cavity.

If a large piece of turf is thrown into a geyser, the eruption may be hastened. The turf plugs the tube and thus causes the lower water to heat up more rapidly. Soap, especially, is believed to hasten a geyser's eruption. The Chinaman's Spring has become famous for an accidental eruption that is said to have been provoked when a Chinese laundryman was washing his clothes in it. His soap or a piece of clothing dropped down in, and the geyser threw his wash some 40 feet into the air. The intentional use of soap or other material for this purpose is frowned upon by park authorities.

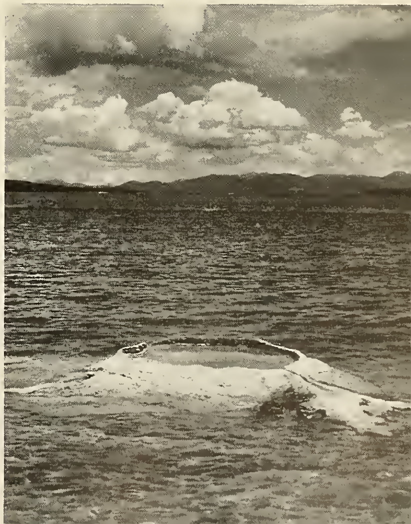
Fears that Old Faithful may be "losing its pep" are entirely unjustified, according to Dr. Philip F. Fix, who has recently made a study of its modern performance in comparison with all the earlier records. The famous geyser erupts just as often and plays to the same height as it did in 1870, according to Dr. Fix's studies, published in the April

➤ **Punch Bowl Spring** is delightfully colored, and it bubbles constantly in a particularly attractive setting

▼ **Angel Terrace** provides a wintry scene in summer. The spring has sheathed the ground with gleaming deposits, killing the trees that were caught in its path

▼ **Fishing Cone.** When the level of Yellowstone Lake is low, it is possible to walk over to this cone of hot water rising from the cold basin of the lake. Fishing is not permitted from the cone, but old stories tell how one could catch fish in the cold water and cook them a few inches away in the hot.

Geysers and hot springs alone do not make Yellowstone an incomparable spot for the student of nature. Remarkable opportunities to observe wildlife and a wide assortment of geologic oddities, from petrified forests to entrancing gorges, place it high among the world's true wonderlands

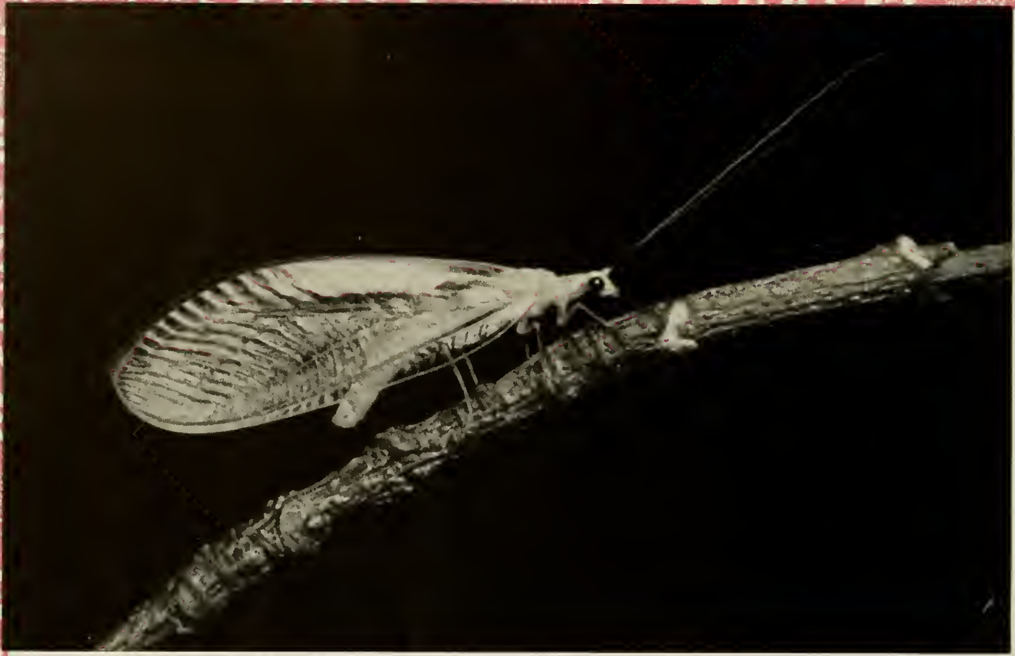


issue of the *American Journal of Science*. It also apparently discharges the same volume of water as it did in 1870.

Old Faithful is not always as regular as popular reputation implies. In 1948, it erupted twice only 33 minutes apart, and on one occasion in 1941 it waited 91 minutes. But these are the recorded extremes, and in *average* interval, it is amazingly dependable. Precise records taken 70 years apart show only a difference of about a second in the average interval of 65 minutes, 6 and a fraction seconds.

The quantity of water discharged each time by Old Faithful has often been exaggerated, Dr. Fix explains. A figure commonly given is 750,000 gallons, but fairly accurate gauging 20 years ago estimated the quantity to be between 10,000 and 12,000 gallons. The height of the eruption is usually about 120 to 150 feet.

Much additional information of interest on geysers can be found in *Hot Springs of the Yellowstone National Park*, by E. T. Allen and Arthur L. Day. Publication 466 of the Carnegie Institution of Washington, 1935.



▲ **ADULT.** The golden-eyed lacewing fly, about three-quarters of an inch long, has beady, golden eyes and pale green, lacy wings. During the day, it patrols the foliage of trees and shrubs in search of plant lice and other small insects. In the evening, it flutters to the nearest light

GOLDEN-EYED Lacewing Fly

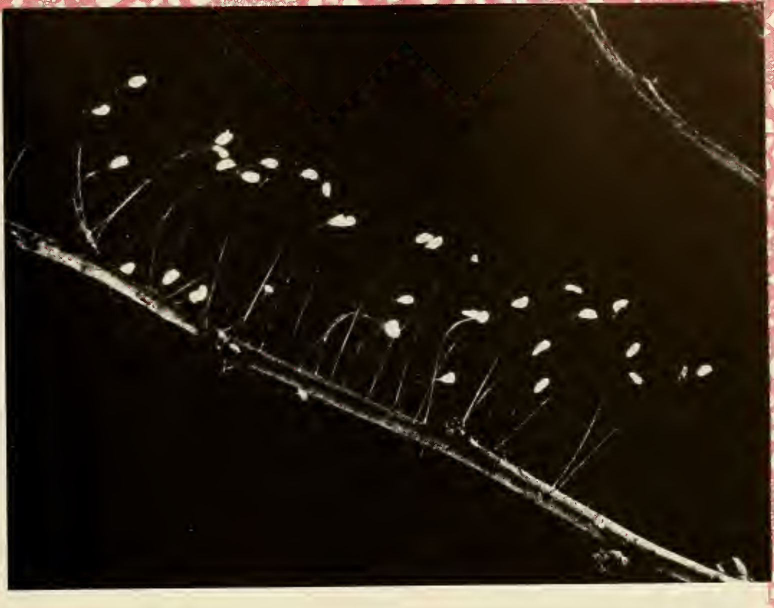
A strange cycle of insect life that almost anyone can observe

By GEORGE A. SMITH

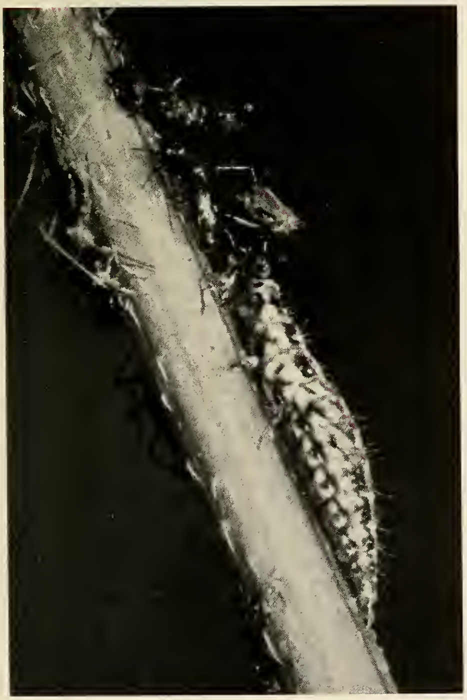
THIS little fairy-winged insect (*Chrysopa oculata*), found throughout most parts of the country, is generally seen in the evening fluttering among low-growing shrubbery. When viewed at close range it is as beautiful as its name suggests, but when crushed, it is liable to give off a sickening odor of which a skunk could well be proud.

The golden-eyed lacewing fly is of particular interest because of the unusual manner in which the female places her eggs. Her young, known as aphis lions, are so hungry when they hatch that the first one out will eat up all the eggs containing the others if it happens to find them. In view of this tendency, it is fortunate that mother lacewing secretes a series of stiff, silklike stalks and attaches an egg to the end of each one. Then when a hungry aphis lion hatches, it crawls down from its egg stalk and goes away in search of something else to eat.

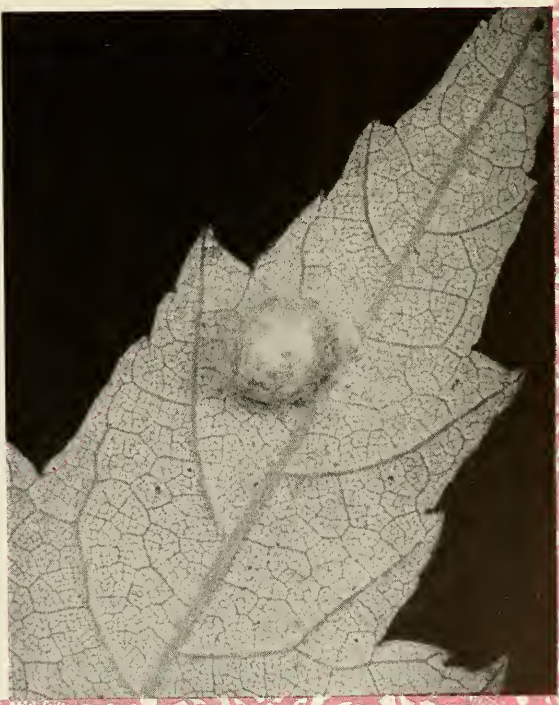
Aphis lions are of great economic importance because they destroy countless numbers of plant lice, as well as many other injurious sap-sucking insects. During its growing period of about 10 days, one aphis lion will devour as many as 300 or 400 plant lice. As it moves over a plant infested with lice, it leaves a graveyard of empty skins behind. So greedy and fearless is this little dragon-shaped larva that it will attack almost anything, from one of its own brothers to the tough skin of a human hand placed in its pathway.



➤ **Eggs.** The female lacewing fly places her eggs on a series of stiff, silklike stalks. There the first of her greedy offspring to hatch will not eat up all the eggs containing the others



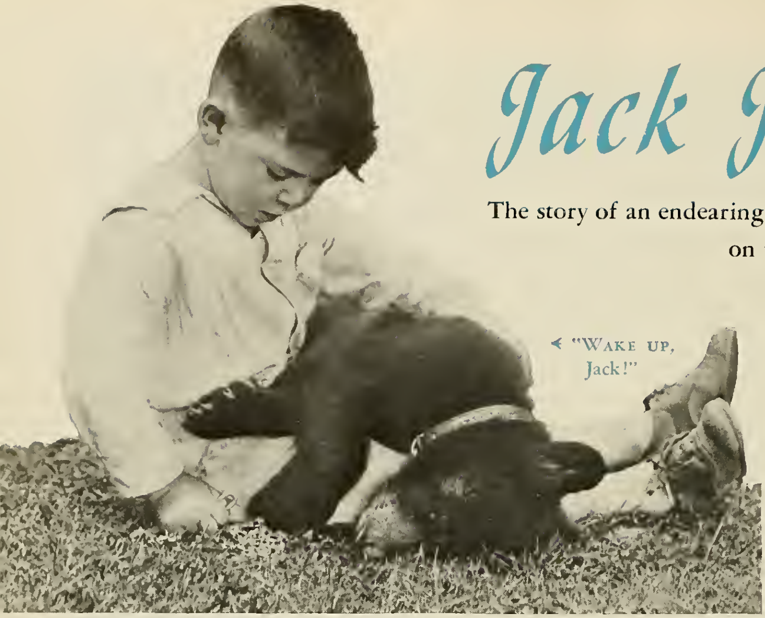
◀ **Larva.** As soon as the larva, known as an aphis lion, hatches, it climbs down from its cradle and goes away in search of juicy plant lice. Picking up the lice one by one in its needle-pointed jaws, it drains them of juices



➤ **Pupa.** After satisfying its appetite, the aphis lion curls up on the underside of a leaf and spins a spherical, silken cocoon around itself. In about sixteen days, the adult lacewing fly emerges by cutting an opening in the cocoon

Jack Johnson

The story of an endearing rebel
on the campus of an eastern college



◂ "WAKE UP, Jack!"

▾ THIS LITTLE MAID cried when he kissed her, but think if he were your size

By LELAND GRIGGS

JACK JOHNSON, a worthy namesake of a famous American pugilist, entered Dartmouth College directly from the backwoods of Maine. His career was not unlike that of many a college boy: he wasted his time in outside activities, such as out-of-town trips, picnics, and athletics. He flunked out at the end of his freshman year, and he has never returned to a class reunion.

There is a strange myth abroad in the north country that little bears are really not "born" at all. When I asked an old river warden in Newfoundland where they did come from, he told me that they were created by the devil without either father or mother. Jack certainly had plenty of the devil in him; but there is no doubt that he was born in a perfectly natural way while his mother was asleep in her winter den. At birth, if he was a normal bear cub, he was a tiny helpless thing weighing less than a pound. When he came to me in early spring he was about the size of a small house cat.

At first he was a lean, sickly, and very homesick cub, requiring more care than I could give him. I put him out to board with a kindly old lady who had always shown much interest in my pets. She took him into her home and gave him the best of motherly care. By day he was tied to a leg of her kitchen stove, and by night he slept in a box in a warm corner behind the stove. Every time he cried, she took him in her arms, patted him, and gave him a saucer of milk. For exercise she took him to walk twice a day, up and down the village street. Under this treat-

▲ His daily bath

ment he soon became fat and happy. When I took him back, he was in the pink of condition.

A student of animal behavior once remarked that a kitten is a shapeless mass of protoplasm until it molds itself into a cat by exercise, especially by play. Jack acted on this theory; he spent most of his waking hours in vigorous play. His first playmate was a puppy that lived next door; but this arrangement was not very satisfactory, for the puppy played one game and Jack another. Jack wanted to box and hug—a bear's normal method of defense—while the puppy tried to learn the art of hamstringing and throttling. Each, of course, unbeknown to himself, was preparing for his own special part in the struggle for existence. Jack, puzzled and irritated by the puppy's style of play, once spied a cat asleep on the porch. Perhaps a cat would know how to box; but in this he was very much mistaken. When he cautiously sneaked up on puss and gave her a smart uppercut to the jaw, she flew into a rage and scratched his face. Poor Jack, who outweighed the cat by several pounds, came whimpering back to me with a bloody nose. He never took on a second cat.

After the small boys and girls of the village discovered Jack, he had plenty of company every day, ready for any sort of play. But he was only a little cub, quickly tiring of a roughhouse, often falling asleep right in the middle of a game. Sometimes the boys would drag him around the lawn by a hind leg without waking him—but I am not so sure he was as sound asleep as he appeared to be. Once a little fellow of about five years old was trying to rouse him, when the bear suddenly came to, grabbed the kid by the heels, and slammed him down on his face. This boy was usually very well behaved and never used any swear words; but that was just too much. He came up to me sobbing and stuttering, "Doc, I am sick of this damn foolishness." It was a long time before I ventured to tell the kid's mother of this shocking incident.

Jack was an affectionate little scamp who loved to hug and kiss his playmates. On one occasion, after sitting quietly for a few minutes in the lap of a little maid, he suddenly gave her such a hug and smack as drove her into the house bawling. No wonder! He always gave a rugged kiss, and if he did not like the taste he followed it with a smart box on the ears.

Jack liked to visit the boys' camps near Hanover. Needless to say, he was always welcome, especially at swimming time. Although he was a clumsy little cub, he was as good as the rest in the water. If, after a race or two and some snapping at bare heels, that old tired feeling came over him and he crawled out on the shore for a nap, he was usually tossed right in again. The rougher the play the better; Jack was no quitter at that kind of game. He stayed with the boys until a counselor blew the "all out" whistle.

Jack also made many friends among the older folks. Everybody knew him by name. One day on my way home to dinner we were passing a workman who had just opened his lunch box. The man offered the bear a ham sandwich, which made a mere mouthful; then a second sandwich followed the first, and a third and a fourth until the sandwiches were all gone. Next Jack grabbed the mince pie out of the man's hand. Even the coffee disappeared to the last drop. I offered the poor hungry workman a half dollar for a dinner at a lunch cart, but he refused saying he had never enjoyed a meal more.

As Jack grew older he began to

▲ He would box your ears one minute . . .

. . . And kiss you the next

lose friends. One such person was a kind-hearted old lady who lived in the next street. Every time we passed her door she came out with a cookie or a piece of candy for the "little dear," as she called him. But when she offered him a drink of milk in a small glass, too narrow for his big muzzle, he proceeded to knock the glass, milk and all, into the middle of the street, and, not content with that show of temper, he tore off about a square yard of the lady's pink skirt—and that square yard was about all there was to that particular skirt. Jack brought me the skirt; but since neither Jack nor I had any use for such a garment, I folded it up and left it on the lawn. She never called him "little dear" again. Every time after that day when she saw the bear coming, she ran into the house, slamming and locking the door behind her.

Jack also managed to get in wrong with the rector of the church that I attended and for whom I acted as chauffeur. This good man was traveling all over the county visiting the sick and conducting missions—"saving souls" as I called it. I believed that we could save more souls if we took Jack along as an added attraction in drawing a crowd of sinners. We tried the experiment, and all went well until Jack performed a little trick that the college boys had taught him—untying knots, especially shoestrings. When my rector found that he could not tie his shoestrings as fast as the bear could untie them, he insisted that we leave the bear at home, as he thought it undignified for the rector of St. Thomas Church to ride through the main street of the village with his feet over the windshield of the car. And, furthermore, he said that there was really no truth whatever in my ridiculous statement that with the help of a bear we were saving "four or five souls to the gallon of gas."

One by one Jack's old friends dropped away; but the college boys stayed by him to the end. They taught him many tricks to which I never gave official approval. Every bear, of course, knows how to hug; but Jack was taught to turn an ordinary bear's hug into a hard, low football tackle around the ankles. He sometimes dropped his victim right in his tracks.

One morning as I was on my way to class, a freshman happened to be strolling across the campus, his hands in his pockets, his little green cap on the back of his head, never dreaming of impending danger. Somebody called out to me, "Let's see if Jack will take him on." It looked like a long chase, but I gave the signal, "Go get him Jack," and away he went. He made a splendid tackle and dropped the poor freshman flat on his face. There was great applause from the spectators as Jack galloped back to me, much pleased with his success. I afterwards apologized to the freshman, who admitted that, although he had heard that Dartmouth was a wild place, he was greatly surprised to be attacked by a bear right in the middle of the campus.

This little trick of a football tackle once led to a near tragedy. As Jack was starting to tackle a student, a finely dressed gentleman came around the corner by the Hanover Inn just in time to get the tackle meant for another. The poor gentleman was considerably disturbed. Even after the students had explained that it was really an honor to meet the famous Jack Johnson, he turned away in anger, muttering to himself that this was to be his last trip to Dartmouth College.

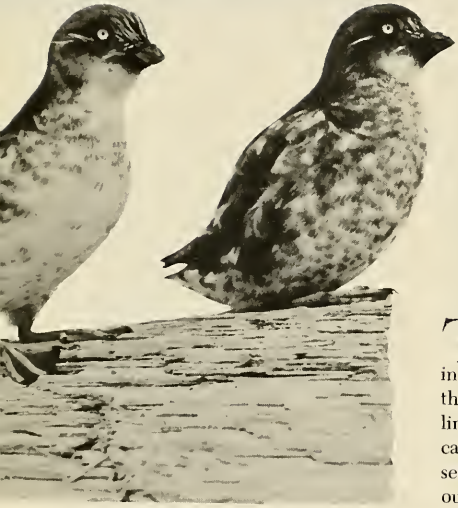
Jack was invited to join the Dartmouth Outing Club and became one of its most active members. He attended all the strawberry shortcake feeds that were held that summer. Since he was too tired and lazy to tramp very far, he was carried in a big pack basket by one of the heelers of the Club. He thoroughly enjoyed these trips, standing up with his paws on the edge of the basket, viewing the landscape and now and then taking a nip out of the heeler's neck. As soon as he arrived at an Outing Club cabin, he stretched himself out on the porch in the warm sun and slept there until the sun went down, when he dragged his bones into the cabin and sprawled out by the fireplace. Nobody disturbed him until supper was over. Since it was a rule of the Club that every member must do his share of the work, Jack had to get busy. He could not be trusted to hull strawberries, but he made a very good dish-washer. As soon as the feast was ended, some heeler hauled him up on the table. He made the circle of the great dining table licking every dish perfectly clean, doing a much better job than the heelers ever did with their dish mops and towels. Everything disappeared — cream, potato salad, coffee, lemonade, and on one occasion even a bouquet of violets. When the work was over, he jumped down by the fire again. With a deep bearish sigh of content he fell asleep, his black belly blown up like a football.

Jack had many other invitations, one of which caused me much anxiety. It came from William Jewett Tucker, ex-president of Dartmouth College. Dr. Tucker had long since retired, but, although an invalid and confined to his room, he never lost his keen interest in all things that pertained to Dartmouth. The college men of my time looked upon him as a sort of saint and holy man, and although I knew that Jack Johnson had little respect for God, man, or the devil, we accepted the invitation to make a friendly call. I gave the bear a bath, fluffed up his fine glossy black fur, put a big blue ribbon around his neck, and off we went. Mrs. Tucker met us at the door and led us into the sickroom where the old, white-haired man was lying on his couch. Jack behaved very well for a bear. He walked up to the couch, stood on his hind legs with one paw on the edge of the couch, and offered the other paw for a handshake. With this little ceremony over, he climbed into a chair and proceeded to rock back and forth until his eye caught sight of the doily on the back of the chair. It was tied with four bowknots! He promptly untied the knots one after another until the doily was free; then he sat there waving it about in great delight. But I knew he would soon be ready for more mischief and suspected that he might be casting an eye on Mrs. Tucker's shoestrings. I bade my hosts good-by, and we departed. I knew by Dr. Tucker's smiles and chuckles that our visit had been successful. As a freshman I had sat in the college chapel and gazed in awe and reverence at the president's inspired face, never dreaming that some day I should see him shaking hands with a bear.

In the fall, as the frosty mornings appeared, Jack began to make preparations for his long winter sleep. His appetite was boundless; he ate everything that came his way, from ice cream to June bugs. While he was laying on his reserve fat, he must have consumed several bushels of carrots as well as a large supply of sweet potatoes and dog biscuit. He worked every day stuffing leaves and rubbish into his den until he had a good soft, warm bed. One morning in early December after a big snowstorm, he failed to appear, and I shoveled a huge pile of snow all over his den. I never saw hide nor hair of him until March, when he reappeared apparently none the worse for his long nap.

As the summer wore on I decided that it was high time for Jack and me to part. He rarely showed any temper, but he was getting rough and hard to handle. An old friend of mine from Springfield, Vermont, had asked for him and had promised to be very good to him. I summoned this new master to come and take Jack Johnson away. One evening the man drove up in an old model T. Jack jumped in beside him on the front seat, and they drove down the street and around the corner. Jack never said good-by nor even looked back. I never saw his homely black face again.

▼ Doormat at an outing club cabin



Choochkies

By Karl W. Kenyon
U. S. Fish and Wildlife Service

Photographs by the author

When the Least Auklets abandon their rocky nests for less tempestuous seas, the islanders of the north know that the somber grip of winter will soon take hold

THE misty north wind ruffles their feathers as they perch in scolding, chirping bands along the wave-tossed boulder crests that line Pribilof beaches. The Aleuts call them Choochkies, which to me seems much more appropriate than our prosaic Least Auklet. No larger than a robin without a tail, they were the first birds to catch my eye as we approached St. Paul Island's foggy cliffs. Like swarms of giant bees, flock after flock sped on whirring wings close over the Bering's dull waters and then vanished in the mist.

➤ THE CHOOCHKIE'S FACE is decorated with short whisker-like plumes. Their color pattern is variable, as shown here. In winter, the mottled breast becomes white

➤ MUCH ROCK-ROLLING is needed to find these birds deep in the crevices among the tumbled boulders of the Pribilof beaches

▲ As they sweep in over the cliffs toward the inland nesting grounds, many Least Auklets are caught in nets held aloft by Aleut hunters

Beneath the weather-rounded boulders of the beach, where the fur seals gather to bear their young and carry on their noisy courtship, or among the moss- and lichen-covered rocks of inland island slopes, these diminutive members of the auk family appear equally at home. They choose to place their single white egg in a deep recess beneath the tumbled boulders or in some crevice of the basaltic cliffs and talus slopes. When they choose the rocks of a seal rookery as a nest site, they apparently care little about the bleating and slapping of flippers raising a steady din above their heads. Fearless of the bickering swarms of seals, the choochkies dodge in among their noisy neighbors, alight near their home crevice, snatch a quick glance at the seals, then vanish among the rocks, chittering and muttering.

Their home-coming, though, is not always peaceful. Once as I watched the constantly moving seaside panorama of seals and birds, I saw a choochkie attempting to land on a rock that lay almost under the nose of a harassed cow seal. The little bird made several attempts to land, but the seal invariably snapped at it, just as a dog might snap at a buzzing fly. The bird was not easily discouraged. It circled repeatedly out over the water, then back toward its chosen rock. Suddenly the seal became involved with a near-by animal in an

▲ The Least Auklet feeds on shrimplike crustaceans of the sea. Webbed feet are aided by wing motions underwater, so that the bird may be said to fly both above and below the surface

◀ A downy Least Auklet just taken from its burrow beneath the cobbles of a Pribilof beach by a native islander, Alex Galanin argument over her rookery space, and in the ensuing confusion the choochkie deftly swerved to a landing and slipped out of sight. Apparently, seals have little taste for birds and seldom concern themselves with their tiny neighbors.

Choochkies are birds of the North Pacific and Bering Sea and are seldom seen, even in winter, as far south as the coast of Washington. Unimportant as they may seem to us, they are a happy sign of coming spring to the winter-bound Aleutian and Pribilof Islanders. When the choochkies arrive, the natives know that the grip of winter has broken. Even while drifted snow lies packed deep in the little gullies and among the rocks, the choochkies hurtle over the beaches and cliffs, headed toward favored nesting spots.

During the long winter months hunting is poor on the islands, and the springtime choochkies are a welcome table luxury. As they arrive the Aleuts set out to catch them, much as the Eskimos of Greenland gather the dovekies that live in similar spots along the shores of the North Atlantic. Armed with oversized dip nets, the Aleut men and boys hide along cliff edges where the choochkies pass. Heavy-bodied and small of wing, the birds maneuver poorly on short notice. As a flock approaches, nets shoot up, and an unlucky bird or two is gathered from midair. Unlike the Eskimos, the Aleuts prefer their birds cooked rather than raw.

I once watched several of the younger boys catching choochkies without nets. They hid among the rocks just beyond the breaking surf, where flocks habitually passed. As the birds flew in low overhead, the boys swung at them with short sticks. Surprisingly enough, they knocked down several. Choochkies are inquisitive, and the boys have discovered a trick that brings additional flocks into range. Crouching among the rocks, almost out of sight, the hunter holds up a dead choochkie. As a flock approaches he shakes the dead bird rapidly, making it appear to flutter. His other hand is ready with the stick, and as the flock veers to investigate, a skillfully aimed swing may bring down another tasty morsel for dinner.

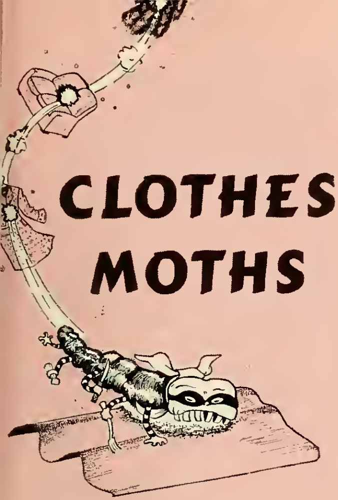
By the time egg laying begins, choochkie hunting is over and the birds continue their summer nesting season unmolested by human hunters. This was not true in years past. One day on St. Paul I was talking to Gabe Stepetin, a native of the Pribilofs and a senior member of the community. He mentioned that when he was a boy the people gathered the eggs of the choochkies as well as the birds. He went on to say: "Pretty soon the big colonies near the village began to get smaller, so we have not taken the eggs for many years. When I was a boy it was no trouble to go out and gather a whole canful of choochkie eggs in a morning." Since the eggs are no longer taken for food, the birds apparently hold their own very well. Such numbers of them swarm about the islands that the small percentage now taken for food apparently has no effect on the population.

Of the two Pribilof islands, St. George attracts more nesting choochkies than St. Paul. But on St. George, the largest colonies are nearly a mile from the sea along broken, rocky slopes and hillsides, whereas on St. Paul they nest only among the boulders of the beach.

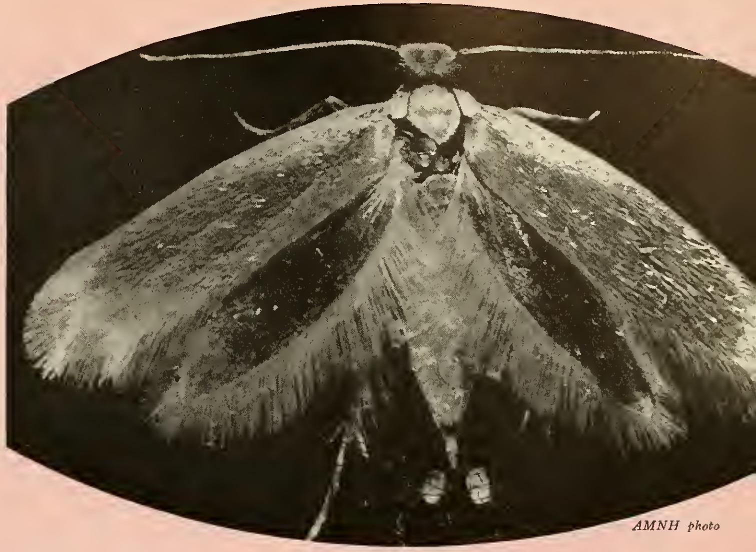
The Pribilof blue fox is numerous on both islands and apparently makes the nesting grounds somewhat hazardous for unwary birds. One morning I hiked across one of these nesting colonies while groups of choochkies scolded from every lichen-covered boulder. A little way ahead a blue fox scampered nimbly from among the rocks and, after staring boldly in my direction, took up an escort position about 50 yards ahead of me. He trotted over the rough terrain at just my walking speed, watching the birds and causing them to dart into the air or disappear among the rocks as he approached. Suddenly an unwary bird popped from a crevice. It was headed toward the fox and seemed unable to gain altitude rapidly. Hardly breaking his step, the fox threw his muzzle up just as the bird passed and snatched it from full flight. With little more than a faint flutter, it hung lifeless in his jaws. Such episodes must frequently be repeated, yet both choochkies and foxes have probably been on the islands for centuries and the large bird population continues.

Choochkies gather their living from beneath the sea, where, like others of the auk family, they use their wings to help in swimming. Unhampered by table manners, they approach their nesting grounds and waiting chicks with not only a mouthful but a throatful, as well. Frequently, in this overstuffed condition, they sit along the tops of the rocks near their homes to chirp and enjoy the company of their neighbors. While sitting thus, it is a common sight to see the small crustaceans that they have recently gathered oozing from the edges of their bills. When they feel that something may be lost, they jerk their heads upward, making several quick gulping motions. In this way, they are apparently able to keep their own meal and the one reserved for their young settled in place. A chick that an Aleut boy had dug from beneath the rocks was stuffed so full of the little pink, shrimplike crustaceans that they constantly protruded from the corners of its bill.

Early to arrive on the Pribilofs, the choochkies are also one of the first birds to leave as summer closes. In early August I hiked along the rocky beaches where a few weeks before choochkie notes sounded from beneath every rock, but I found that none remained. Unlike other island nesting sea birds, they leave well in advance of stormy fall weather, to pass the winter at sea from the Aleutians and the Commander Islands south as far as Japan. November's winds were heaping up stormy seas when I last saw choochkies. We had headed south and were leaving the tempestuous Bering Sea to enter the sheltered Aleutian passes. Little flocks of ten to twenty choochkies burst from the dark sea ahead or dived from sight when our dipping bow tossed forth a deluge of spray.



CLOTHES MOTHS


AMNH photo

▲ **A FEMALE CLOTHES MOTH** laying eggs. She herself is a harmless creature, completely without appetite—but she can produce 100 or more ravenous larvae

By C. H. CURRAN

Curator, Department of Insects and Spiders,
American Museum of Natural History

How to know them when you see them, and how to protect your furs and fabrics from their ravages

CLOTHES moths are generally considered to be Public Enemy No. 1 by the American housewife. Her husband may have the same idea, and with good cause. There is scarcely a family that has not suffered from the depredations of these tiny but voracious creatures, and once they become established in a household they are difficult to dislodge. The size of the adult moth is about twice that of a large grain of rice. Their live weight is about equal to the rice, and it would require five or more dead specimens, from which the moisture has evaporated, to equal the weight of a lusty living specimen.

The three kinds of moths that attack our clothes originated in Europe, and they have probably been associated with man from the time he began using fur for clothing. Unused or discarded pieces of fur about his primitive dwellings would have provided ideal breeding places for the moths, just as fur coats that are not in constant use do today. Primitive man probably paid no attention to the tiny yellowish or grayish moths that rested on fur pieces. He was very different from the housewife of today, who becomes alarmed at the sight of any small moth in any part of the house and rushes to kill it. Quite often the offending moth is a harmless creature that has flown in through the window, attracted by the lights in the home. More often the moth may be one of those that feed on cereals, nuts, or dried fruits—insects that originate in the kitchen rather than in the clothes closet, chest of drawers, or storage trunk. Almost 90 per cent of the moths brought to the American Museum by alarmed housewives belong in this latter category; less than 10 per cent are clothes moths.

It is very doubtful if householders see five per cent of the clothes moths in their home. Like almost all moths, the adults are naturally nocturnal and fly only at night unless disturbed; but they may fly about a room on dark days or when the blinds are drawn. Unlike most moths, they are not attracted to light but always prefer shadows and dark places. They have become so accustomed to darkness that they are able to survive in sunshine for only a few hours. Thus when a clothes moth flits about a lighted room in order to find new materials upon which to lay its eggs, it will usually hug the shadows. And it is most adept at escaping from clapping hands and a vigorously wielded fly swatter. For a moth, it can run extremely fast and can quickly sidle out of sight behind some piece of furniture. If the moth you are chasing lands on a bright area and makes no attempt to reach the shadows, it is almost surely *not* a clothes moth.

Unfortunately, the killing of an adult clothes moth is not of much importance in preventing damage. The only possible advantage would be in killing a female that still had most of her hundred or more eggs to lay. It is not the winged form that eats your clothing. The adult moth eats nothing. During the caterpillar stage, clothes moths eat enough to last the rest of their lives. Enough nourishment is stored by the caterpillar to enable it to build its cocoon and change to the pupal stage, the process whereby all the elements in the body break down and ultimately reassemble in the form of a moth whose only duty is to propagate its kind.

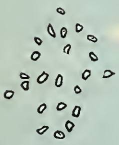
There is some question as to which of the clothes moths is the most destructive. This is not because the larvae of any particular species eat more than another kind but because one species predominates in some parts of the country or in some parts of a state. An inexperienced person has difficulty in recognizing the two common forms. The Webbing Clothes Moth is the only one that has come to my attention, with one single exception, yet many entomologists state that the Case-bearing Clothes Moth is the most common! Not a single case-bearer has been brought to the American Museum in the past 20 years, and in all the buildings I have examined, the pest has always been the webbing one.

The webbing clothes moth is known as *Tineola bisselliella*, and the adult is readily recognized when one becomes familiar with it. It is creamy in color, with a brick-red head, pointed wings, and a length of approximately a quarter of an inch. Specimens brought in for identification are usually badly mangled from having been crushed. Sufficient experience enables one to identify them, though with most small moths a nearly perfect specimen is usually necessary.

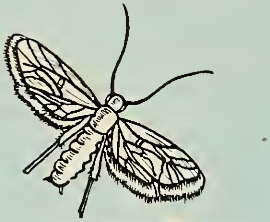
The *Tineola* larva is quite characteristic because it spins silk wherever it goes. As it feeds, it more or less covers itself with a silken canopy; and if it wanders from the tunnel it has eaten in your clothing or bedding, it leaves a silken trail, possibly to enable it to return to its original grounds. As a general rule, the caterpillar is able to find sufficient food for its full growth within an inch or less of the place where it starts feeding; but if it finds the food there untasty, it will travel, nibbling as it goes (and leaving a silken trail), until it finds a spot to its liking. It is *Tineola's* habit of building an extra-heavy canopy over its principal feeding place that causes it to be confused with the case-bearing species.

▼ THE CLOTHES MOTH destroys only when it is a caterpillar, but it's in the housewife's interest to kill it in every stage. A turning point in man's age-old warfare against this insect can be gained through wise use of modern remedies

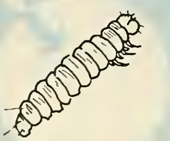
LIFE CYCLE OF THE CLOTHES MOTH



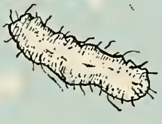
The eggs of the clothes moth are layed singly in places where the caterpillars will find food. Preferred places are stained or soiled parts of clothing and other woolens or lint-filled cracks in floors and walls. Dry cleaning protects articles.



The webbing clothes moth is creamy in color, with a reddish head. The case-bearing clothes moth is dull cream, with dark spots on the wings. The moth itself is entirely harmless, since it takes no food of any kind. But its presence is a warning of potential damage.



When the larva, or caterpillar, is removed from its case or tunnel, it looks like this. It is only during the caterpillar stage that materials valued by householders are destroyed.



The silken cocoon of the clothes moth contains the pupa in a sarcophagous-like case. Inside this the essential organs of the ·caterpillar break down and reassemble to produce the flying insect.

The larva of *Tinea pellionella* builds and carries its own house around with it. Externally, the case looks like the material upon which the caterpillar is feeding, because it is composed of short, chewed-off pieces of that material fastened together with silk. If the material should be a plaid, the pattern would be lost because there would be a blend of the various colors. Because the caterpillar adds to its house as it grows, many who have reared the moth to study its life history have amused themselves by feeding the larvae different colored wools at different times so as to produce cases of intriguing patterns.

Regardless of how the outside of the case may look, the inside always bears a stout lining of smooth, pure white silk. Since the case is built as soon as the newly born larva begins to feed, it must be frequently enlarged, and the caterpillar has evolved a most efficient manner of doing this. It is the same procedure that a tailor follows when he has to let out trousers to accommodate the expanding midriff of a gentleman who is becoming portly. The offending trousers are ripped from the top at the seams, and a long, narrow, V-shaped enlargement is made. The case-building larva has no seam to cut, since the case is solidly woven silk. But it has no real worry. It merely chews a narrow line in the case from the front end to a little behind the middle, forces the resulting slit well open, and fills the space with new lining. Then it repeats the process on the opposite side. One end of the house having now been enlarged, the caterpillar turns around and goes through the same procedure at the other end. Obviously, this process would soon result in a silken, wool-covered case that would be much constricted in the middle. But the caterpillar takes care of this by slitting the case in the middle, spreading it, covering it on the outside with pieces of its foodstuff, and lining the inside with new soft silk.

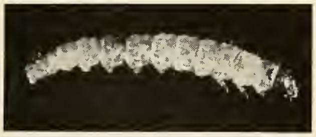
The case-bearing clothes moth produces only one generation each year. When the larva has become full-grown in the fall, it walks off in its case and seeks a place in which to spend the winter. It may crawl from carpets or clothing upon which it has fed to the underside of a shelf or ceiling or into any crevice that will provide protection. In such a place it remains in a torpid condition until the following spring, when it changes to a pupa. About three weeks later the adult moth emerges. If it is a female, she finds a mate, then goes about the essential business of locating suitable material upon which to lay her eggs. The adult moth is dull-cream in color, with a number of dark spots on the front wings and paler, unspotted hind wings.

The third species, *Tricophaga tapetezella,* is not too common in America, but where it occurs, it causes fully as much destruction as the other kinds. It usually shows a strong preference for furs and woolens, in which it builds silk-lined tunnels that enable it to move at will from one feeding place to another. It pupates within a tunnel. Perhaps its chief interest lies in the fact that it is known to breed in the pellets of indigestible bones and fur regurgitated by owls. The eggs are laid in the pellets during the warm days of spring, and the larvae grow to maturity by fall. This moth is supposed to be the only one of our clothes moths that is able to survive northern winters out of doors. Its outdoor life history has not been thoroughly studied in North America, and we cannot state positively whether it can survive if there is not a heavy protective covering of snow. Actually, the moths that lay eggs in owl pellets may have passed the winter in infested buildings.

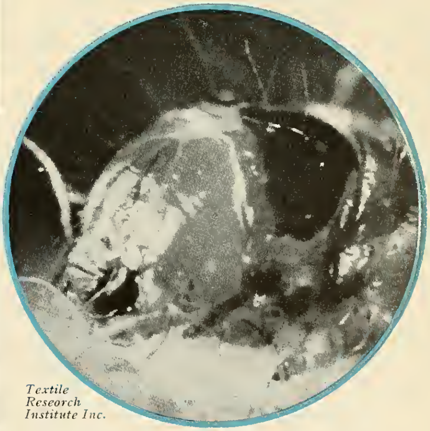
According to all the textbooks, clothes moths feed only upon animal products, and the list is a rather long one. If we wish to make it short, we may say in a very general way that the larvae feed upon fur (hair) or feathers, which may be classified as modified hairs. They also feed upon casein and milk products. They are not supposed to feed upon plant products or silk, but one of the heaviest infestations I have seen occurred in cheesecloth —and, strangely enough, woolen goods in the same home were not attacked.

This particular infestation occurred in Canada at a time when I was running the first test of calcium cyanide as a fumigant for insects in flour mills. An uncle informed me that his house was full of clothes moths and asked me to investigate, hoping, I am sure, that I would fumigate his home. I examined the house. There were numerous clothes moths flying about, since the blinds had been kept down, but I could find no trace of moth damage in carpets or other woolen goods. The attic had more moths than any other part of the house, yet I could find no woolens stored there. The only thing in the attic, other than wooden furniture, was a huge box of cheesecloth that had been used as insect screening during the summer. Naturally, I was not interested in that, and it was only after I had left the attic that I decided to take a look at it. When I opened the box, my eyes popped. Clothes moths were swarming over the cheesecloth by the hundreds, and a casual examination showed that it was interwoven with the webs of the webbing clothes moth. I quickly closed the top and gave instructions to have the whole thing taken to the back yard and burned. This was done, and the infestation disappeared. In this case the cheesecloth had been used two seasons before and had not been washed before storing. It probably had entrapped thousands of small insects and, in spots, had become stained by grease. It provided an ideal breeding place for the moths, and

AMNH photo



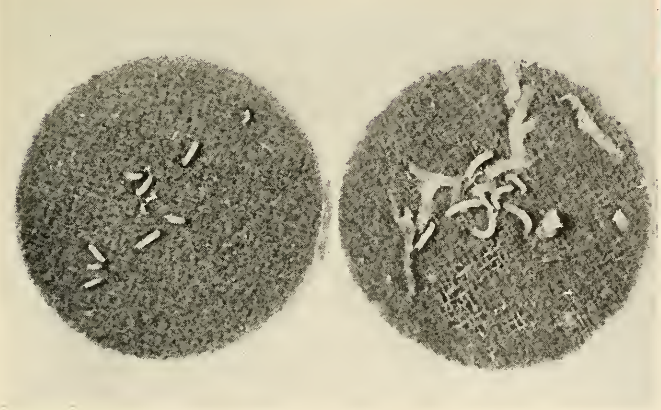
⮝ THE LARVAE of the clothes moth



Textile Research Institute Inc.

⮝ IN TYPICAL EATING POSITION: the lowered head of the larva, with lower jaw pushed into the nap. The creature often finds all the food for its growth within an inch of where it starts feeding

Photo courtesy Du Pont Co.



⮜ TREATED FABRIC unharmed (*left*); untreated fabric badly damaged (*right*)

International News Photo

▲ A PERFECTLY CLEAN coat in an airtight bag will stay moth-free, but it's safer to rely on cold storage. Larvae are inactive below 40 degrees F.

they made the most of the opportunity.

A chief source of infestation is soundproofing material. At one time, felt was commonly used for this purpose. It is still used for insulating water and heating pipes and as a cushion in hangers in the flooring. Once these felts become infested, the moths will come out wherever they can find an opening, and the whole building is exposed to their attack. How the moths find their way into the felt is a mystery. They breed there by the millions; those that find their way out attack carpets, clothing, and furniture.

Where clothes moths are observed flying about in numbers that are really alarming—ten or more a day—the chief source of supply may be some rather small, unnoticed object. In one apartment a thorough examination of carpets and closets revealed only two or three larvae. Attention finally focused on a stuffed owl that stared wisely from the top of a tall bookcase. When its feathers were ruffled, moths swarmed from it, and beneath what seemed to be outward complacency there was a labyrinth of silken tunnels and threads.

At a summer home in central New York State a moose head, which for 20 years had gazed mournfully from above the fireplace, was the cause of an annual infestation in a New York apartment many miles away. The moths swarmed from the head and laid their eggs upon blankets and woolen clothes that hung unused during the warm summer months. Blankets brought back from the country were found to be infested each year.

For several years, clothes moths appeared in considerable numbers in my office at the Museum. I was not worried because there was nothing in the office that could be damaged. Finally I became curious and made a thorough search. In the back of a coat closet, tucked in a pair of high boots, were the remains of a pair of woolen socks that had been stored a few years before in anticipation of another field trip. Later, the original source of this infestation was found, quite fittingly, in the Lepidoptera room, where a quantity of green felt had been stored, years before, in an unused insect cabinet.

We must not get the idea that all infestations occur in unusual places. Far from it. In a New York City apartment on Park Avenue, where the carpets were deep and springy, the moths flew about freely behind curtains drawn to prevent the sunlight from fading the colors, but very few caterpillars were found about the edges of the rugs. However, in the lush carpeting that covered the stairways, the story was different: dozens of larvae were found on each step and riser. From these almost continuously darkened areas, the moths had spread through the whole apartment, and if left undisturbed they would have eventually infested every square foot of carpeting.

It is generally believed that clothes moths cannot withstand freezing temperatures and that storage of woolen clothing and furs outside during the winter will prevent damage. At one time I shared this belief, but I have long been completely disillusioned. When I returned to Canada after the First World War, I brought back almost no souvenirs, but I did want to preserve my uniform as a reminder of the days I had spent with a famous Scottish regiment. To be sure that nothing would happen to it, I placed it in a trunk with other possessions and put this out on an unheated, enclosed sleeping porch. In winter the temperature was frequently colder than 20 degrees F. below zero for days at a time, and I was certain that everything was safe. It was two or, perhaps, three years before I had occasion to open the trunk, and the sight that met my eyes was anything but heartening. Clothes moths were swarming in the trunk, and my prized kilts were white with webbing and more thoroughly riddled than if subjected to several rounds of buckshot from a twelve-gauge gun.

In those early days of insect control the methods of preventing damage from clothes moths were crude and not too efficient. It may seem foolish to refer to the early 1920's as "early days," but when the conditions of those times are analyzed, one realizes the wonderful advances that have been made during the last 20 years. At that time paradichlorbenzol, commonly known as dichloricide, was unheard of as an insecticide; it was a waste product of industry. Its first use in America was for the protection of museum collections from insect pests, about 1924. Its use as a protection against clothes moths came several years later, and it was not until the early 1930's that it gained its rightful popularity.

Previously, the common procedure against clothes moths had been to pack woolens and furs in moth balls. Camphor was the favorite substance, and I can well remember wearing my winter clothing or my dress suit for several days with the odor of camphor contaminating the pure, fresh air. Of course, my mother hung out all the unentombed clothing in the bright sun to dissipate the telltale odor, but somehow it would cling, and when one came from outside into a warm room, there would be tilting of noses and knowing looks. Then, too, it was embarrassing to have someone remark: "Well, I see you're coming out of the moth balls."

Later came naphthalene balls and crystals. They were much less odorous and their stench less lasting. Also, they were evidently less efficient. It is possible that camphor did kill most clothes moth caterpillars when used in sufficient quantity, but naphthalene kills very few. The best it does is to prevent moths from laying eggs on stored materials.

Early in the present century there developed a belief that cedar chests would prevent damage by clothes moths. The idea probably originated from the fact that grandmother, or great-grandmother, always stored the warm articles used in winter in a cedar chest, and they were never damaged. In the days of grandmother and great-grandmother, cedar was a common wood. There were large trees that yielded fine lumber, and chests made from them had a pleasant odor. We know that some insects do not like certain odors, but it has never been proved that the clothes moth does not like cedar. It might like the odor just as much as we do. Even if it doesn't, cedar chests lose their cedary smell after a few years. The fable about the protective powers of the cedar chest may be explained by the fact that houses in grandmother's day were poorly heated. Often, during the night, the water in the pitcher on the washtable in the bedroom would freeze over. Many times have I broken the ice and doused my shivering face in those cool, health-giving waters. In the cold houses of those days the clothes moths could only indulge in feeding for three or four months of the year, and they did not develop rapidly as they do now in buildings having a temperature of sixty or over almost every day in the year.

Grandmother had one method of protection that will do a good job today. Several times—two to four—during the summer, she would take all the blankets, winter coats, and furs outside and hang them in the bright sunlight to air. She didn't know, of course, that sunlight meant death to the clothes moth caterpillars. Maybe she thought that airing just helped preserve the clothes; but regardless of that, she was employing a wonderful method of clothes moth control. She would also have the carpets and rugs taken outside in spring and autumn and given "a good beating." That was to get the dust and dirt out of them: it got any unwary clothes moth larvae out, too.

Dichloricide ushered in a new era of clothes moth control. For the first time, we had a handy material that would not only keep clothes moths away but would actually kill the larvae. True, it is a slow killer, and even in a sealed trunk it might take a week or more to destroy the pests. It was used, and still is, in various ways. A half pound or more of the crystals, depending upon the size of the area to be protected, may be placed in drawers, trunks, or clothes closets. In the latter it should be placed on the highest shelf in a shallow container, such as a saucer, or hung from the ceiling in a cheesecloth bag. The gas given off is heavier than air, and if a deep container is used, the gas is unable to escape over the sides. Crystals are many times more efficient than "cakes" or pellets. To protect carpets during the summer, they may be lightly sprinkled with dichloricide crystals, then rolled, wrapped, and sealed in heavy paper.

When you use your vacuum cleaner in reverse and blow the fumes of dichloricide over your rugs or carpets, you may be doing some good. However, since the material is a very slow killer it is obvious that such casual treatment is of no lasting value. In my tests I have found that larvae may remain active for at least four days when their woolen foodstuff is covered with crystals; then, when removed to fresh air, they develop normally.

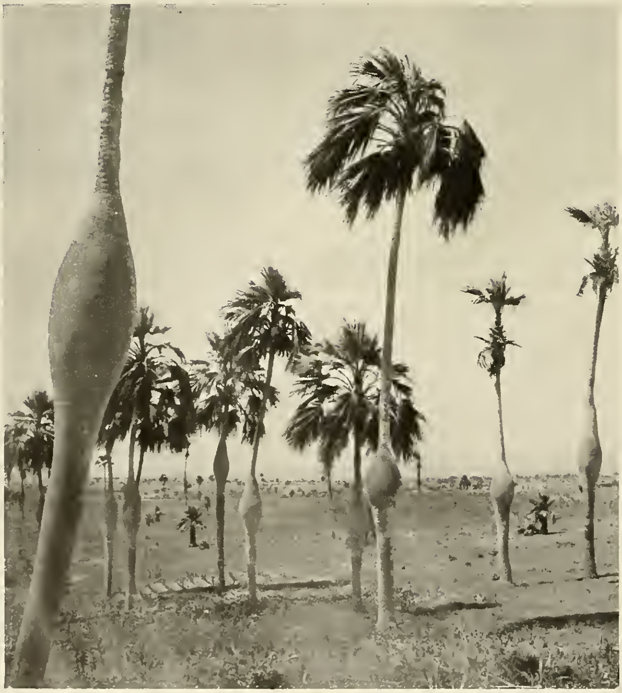
One of the simplest ways to prevent damage to clothing, blankets, and carpets is to place them in cold storage. At temperatures below 40 degrees F., the larvae are wholly inactive, and young larvae are unable to survive two or three months at this temperature. Full-grown larvae, to be sure, may survive such treatment for as much as six months, but in the spring, when you are usually thinking of cold storage, all the larvae are young. Clothing that has been in frequent use does not harbor moths, but it should not be stored at home without first being dry-cleaned, because soiled clothing attracts moths much more than clean clothing. Dry-cleaning kills both eggs and larvae. But you'd better not trust your fur coat to home storage. Better put it in cold storage.

Both of the above procedures are merely emergency measures. To get rid of the pests, you must destroy them where they have become entrenched. After we had moved into our present home, we learned that one closet had a reputation of being heavily infested with clothes moths. Our neighbors told us after we had discovered it ourselves. Every spring and all during the summer an occasional clothes moth and sometimes a half dozen at a time would be seen dancing merrily over the clothing. They had taken up their abode in the lint and dirt that filled the cracks in the floor, shelves, and walls, and deep down in these cracks they were protected by the lint from the fumes of dichloricide and from heavy spraying with rotenone, pyrethrum, and DDT. Each spring, like guerrillas, they would sally forth from their stronghold, and almost inevitably some article of winter clothing would be damaged. Had the closet been kept closed and sealed for several weeks, it is possible that the pests might have been eliminated, but it was in almost daily use.

The moths were driven out of the closet by the use of a special lamp shade heavily impregnated with DDT. The shade was placed over a 50-watt lamp and the light turned on for several days. Later, the lamp was lighted only a few hours a week. The idea seemed fantastic. It did not seem possible that such a simple device could do what really drastic measures failed to accomplish. Three things combined to produce the result. Clothes moths do not like light, and they need a

The Bottle Palm

By Walter Henricks Hodge



L. H. Bailey photo

▲ A BULGING MIDRIFF makes the middle-aged Bottle Palm the butt of various jokes but provides the Cubans with a number of useful objects

On the sandy savannas of extreme western Cuba and on the near-by Isle of Pines grows the Bottle (or Barrel or Belly) Palm, *Colpothrinax Wrightii,* one of the most curious of the great group of palms.

Just what is the purpose of the curious swelling on the trunk is unknown. Possibly it represents a region for the storage of reserve foods. Certain it is that the strange tumid growth does not ordinarily appear until the tree matures, for young trees usually lack the bulge.

Since palms, like most monocotyledons, lack the important cambium layer that causes diameter growth in most trees, the sudden swelling in middle age must be explained as a subsequent swelling of cells already formed. The Cubans, not without humor and seeing a resemblance between their tree and the surplus avoirdupois that sometimes appears among humans, have nicknamed it the *barrigona*—literally the "potbelly" tree.* Moreover, they put it to strange uses. Hollowed out, the swollen sections of trunk occasionally are made into canoes, crude barrels, watering troughs for domestic beasts, or even crude beehives.

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* This is not to be confused with the *barriguda* or "barrel-bellied" tree of Brazil (*Cavanillesia arborea* Schumann), described in the May 1946 issue of Natural History.

certain amount of moisture. The light was unpleasant enough, but the heat also dried the air. In addition, and more important, the heat from the light caused some of the DDT to volatilize and spread through the closet. Air currents were also set up, and fine crystals were carried from the shade and settled on walls, floor, and clothing. For three years now the clothes closet has been safe, and so have others in the house which have received the same treatment.

Not all treatments are so simple. When the infestation is general, drastic procedures are necessary. Where carpets are infested and where the cracks in the floor serve as a continuous source of infestation, there is need of special measures. Spray materials, such as DDT or chlordane, must be forced under high pressure into carpets and into the cracks in the floor. Where insulation is the source, materials must be used that will result in mothproofing. Fumigation with cyanide is useless. This extremely dangerous gas is lighter than air, and even an abnormally heavy dosage will not penetrate carpets or lint. It is work for an entomologist who knows his job.

Cyanide fumigation has a place in moth control, but I do not think it belongs in the home. Pieces of furniture, such as mattresses, rugs, chairs, and couches, may be sent out for treatment in vacuum fumigation chambers, but even this method is not wholly approved because unless moths are completely eliminated in the dwelling, reinfestation may occur. However, it does a fast job, and other control measures may be undertaken while the furnishings are away.

Furniture and mattresses are treated nowadays with some of the new insecticides in a highly volatile, fireproof carrier. Long needles are injected into the packing of the infested article, and the spray forced in under very high pressure. Sufficient gases disseminate through the packing to kill moth larvae, and a protective residue is left.

We repeat that one very simple precaution should always be taken. Clothing and other woolen goods should be dry-cleaned before being stored, to remove any stains or grease: the larvae love contaminated places, and if they find none, the article of clothing may escape damage.

How much damage does the clothes moth do? Well, it probably destroys a half-million suits of clothes and other garments each year, with a value in excess of $25,000,000. Add to this another $10,000,000 or more for cold storage and an additional $10,000,00 for protective chemicals and you get some idea why it pays to keep the clothes moth out of your home.

THE PILOT WHALE AT MARINELAND

Continued from page 308

sleeping at the surface at almost any hour of the day.

There was no doubt in the minds of his captors that at first the young whale was lonely. This was to be expected in a species as gregarious as the pilot whale. For a long time he confined his activities to the south half of the tank, and this was perhaps erroneously interpreted as an effort to place as much distance as possible between himself and the porpoises, which spent much of their time in the north half. Eventually it was realized that this was only due to the fact that the nocturnal whale sought the shade of the southern wall, while the dolphins were more at home in the sunnier portion.

Little by little the whale became accustomed to intimate association with the other animals. Gradually the dolphins came to accept him as a member of the community, and rarely one or more of them would entice him into a game of chase. Usually when they approached in a spirit of playful pugnacity, he threw himself on his back, the better to follow their movements with his eyes. At the end of a series of spirited dashes about the tank, in which the participants (including the whale) sometimes threw themselves out of the water, the dolphins retired to the sunny side and the whale to the shadow side, to rest. The whale squealed through his blowhole just as the dolphins did when excited. One day the whale discovered the jets through which fresh sea water was forced into the tanks. These powerful streams of water coming from the bottom of the tank held a sort of fascination for both the whale and the dolphins. All of them seemed to derive some sort of pleasure from thrusting their heads directly into the powerful stream. It is probable that the torrent exerted a caressing effect on their extremely sensitive hides, and anything that may produce such a feeling is eagerly sought by all the captive cetaceans.

Thus, when an attendant scrubbed the walls of the tank with a scrubbing brush on a pole, the whale came to him to be scrubbed also. Whale and dolphins alike spent many of their waking hours rubbing themselves on the hapless loggerhead and green turtles. The whale, lacking companionship of his own kind overdid this to the extent that he suffered abrasions, particularly to his eyelids, from the claws and sharp beaks of the turtles.

One of the most outstanding play characteristics of porpoises is that of mouthing and tossing into the air dead fishes, pebbles, feathers, and other objects encountered in the tank. So it was not at all surprising when the whale began to take notice of such objects. He had not taken to playing catch but had been observed snatching floating objects from the drain vortex in the center of the tank. He carried them a short distance away, let them go, and followed them back into the whirlpool to take them again and again.

Unhappily, the brief saga of the world's only captive pilot whale was brought to an abrupt close on July 6, almost nine months to the day after his capture. In April, he had received a setback when the bull porpoises, mad with mating fever, had buffeted him mercilessly with their snouts and tails. Although two of the latter were replaced by females, the rough treatment was resumed late in June. About ten days before he died, a decided loss in appetite was noted. It was not until an autopsy was performed that the cause of this was determined.The right ramus of his lower jaw was fractured. Half-healed rib fractures, probably dating to the trouble in April, were also found. Yet he did not starve to death, since, in addition to his blubber, thick layers of adipose tissue were found. His passing was a great loss to Marine Studios not only because he constituted a truly unique exhibit but also because he had become, through his eager response to kindness and good care, endeared to all who were concerned with his welfare.

LETTERS

Continued from page 290

You'll recall in my article about the swans in Alberta (NATURAL HISTORY, Oct., 1948) I mentioned a pair breeding on the ranch of one Joe Tomshak, near Grande Prairie. They should have had eggs this coming year.

The female picked a fight with a moving automobile about a month ago and was killed. Too bad!

DUANE FEATHERSTONHAUGH.
Duanesburg, N. Y.

Beggar's Bowl

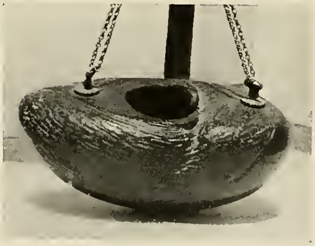
SIRS:

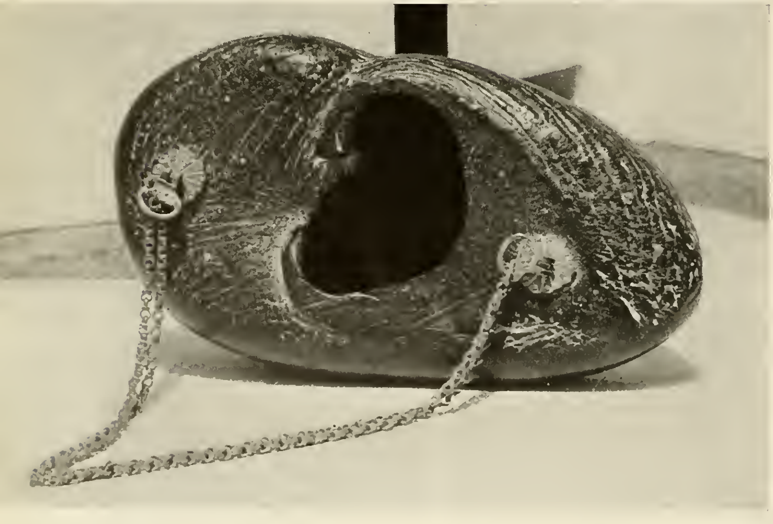
The article you published in the January issue on the largest seed in the world — the Seychelles nut — was most interesting.

Soon after I read the article, I noticed what appeared to be a half section of a Seychelles nut on the arm of a native beggar in the bazaar of Kuwait town, near the head of the Persian Gulf. He was utilizing it as a begging bowl. Later, while visiting in the home of Lt. Colonel and Mrs. H. R. P. Dickson, I asked Mrs. Dickson if she had ever seen one of these bowls and if she could tell me something about its origin. From her collection of Middle East curios she produced a specimen of a half section of Seychelles nut which had been made into a beggar's bowl. I took the accompanying two photographs of it.

Colonel and Mrs. Dickson have resided in Kuwait for over twenty years. He is a retired British Political Agent. Mrs. Dickson has studied the plant and animal life of this area for many years and is considered the local authority on it.

At my request, Mrs. Dickson wrote the following interesting account regarding the Seychelles nut:





"I have spent many years in the Persian Gulf and Iraq, and up to some years ago these half nut-shells were carried by every fakir and beggar from Persia and Afghanistan who wandered through the cities of the Middle East. They are still used today but are not seen so often. In them food and money are collected. Two rings were screwed into the upper overhanging portion, and a chain was attached, through which the beggar put his arm. The inside was completely scooped out, leaving only the wrinkled, veined, and ebony-hard shell. On the outside, usually only a portion of the rough husk was left; the rest was cut away and was polished.

"Among some of the tribes of the lower Euphrates in southern Iraq, this half shell is used today as a drinking cup in the large guest chambers that are made of reeds from the marshes. It is dipped into the large earthenware water jars (*hub*) which stand just inside the entrance of every one of these dark, cool guest or council chambers. The belief is widespread that no matter how sick or ill a person is who may drink from this bowl, the infection cannot be transmitted to anyone drinking after him.

"I have had one of these bowls for many years. It was presented to me by the Sheikh of the Fatla tribe, Sheikh Mizhir bin Faraun, who lived near Um al Barur, Middle Euphrates, on the edge of the marshes.

"It was indeed a high honor to be presented with one of these valued bowls. The Sheikh himself did not know what the bowl was made from or from where it came. He called it *Kashkul*, which is the name by which it is known in these parts.

"Here in Kuwait, the sea captains and sailors who trade between Kuwait, Basrah, India, Zanzibar, and Arabia will tell you that these shells are found washed up on the coast of Goa—Portuguese India. They believe that they are some kind of great oyster shell from the bottom of the sea. Every houschold here many years ago used one of these shells to drink from. They were of various sizes, some small and some large, and they usually had the overhanging top removed. There are still some in use in the Shia Mosques here. They are attached to the wooden stand below the water jars by a small chain passed through a ring on the bowl.

"Some years ago, when some officers of the Royal Navy who were visiting this port saw the bowl hanging in my drawing room, they told me that it was made from the half shell of a very large nut which grew in the Seychelles group of islands."

I thought these extra details might be of interest to some of your readers.

William C. Buie.
Kuwait, Ahmadi, Persian Gulf

"Thanks"

Sirs:

My sincere compliments to you and to your staff on the entire June, 1949, issue of Natural History Magazine.

My personal compliments are of little moment. But in all walks of life I hear many expressions of appreciation from persons of varied interests and occupations, to whom your magazine brings a new appreciation and understanding of the world around them and the interrelations of This with That.

I should like to learn that others also are writing you of their understanding and appreciation of the fine work that the Museum is doing. Your magazine is the only inkling most of us have of what really is going forward.

"Much Interested."
New Jersey

"Stern" Words

Sirs:

As a subscriber to your very excellent magazine, which my family and I enjoy immeasurably, I am taking the liberty of calling your attention to an error in the excellent article, "The Spin of the Sea," by N. J. Berrill.

My daughter and I took the courses at Columbia on oceanography, and Dr. Berrill's article was intensely interesting until I reached page 272, third column, in which Dr. Berrill states:

"At one time a U. S. Coast Guard Cutter lying across the cold wall found the sea temperature at the bow to be 34 degrees and at the stem 56 degrees F."

Someone should have told Dr. Berrill that the bow and the stem are one and the same part of a vessel. The probabilities are that most of your subscribers picked this up, but I just wanted to make sure that you have done so.

Eugene A. Schmitt.
New York, N. Y.

Thanks to Mr. Schmitt's kindly comment regarding this "slip that passed in the night," Natural History Magazine will in future try to remember whether it is coming or going.—Ed.

What About Sex Among Animals?

By Edward Dembitz

With some species of animals, it takes an expert to tell the male from the female. With others, the distinction between the sexes is quite marked, not only in the reproductive organs but in major physical characteristics, habits, and their relationship to man.

The questions below test your awareness of these latter differences. Indicate your opinion on each question by circling either the M (male), the F (female), or the B (both male and female). Then turn to page 334 for the correct answers. A score of twelve right is well above average.

1. Which crickets chirp? . . . . M F B
2. Which African elephants have tusks? . . . . M F B
3. Which nightingales sing? . . . . M F B
4. Which mosquitos bite humans? . . . . M F B
5. Which diamond-back terrapins are marketed for food? M F B
6. Which spiders spin webs? . . . . M F B
7. Which lions have manes? . . . . M F B
8. Which katydids say "Katy-did"? . . . . M F B
9. Which kangaroos have pouches? . . . . M F B
10. Which caribou bear antlers? . . . . M F B
11. Which horseflies bite horses? . . . . M F B
12. Which lyrebirds have lyrelike tails? . . . . M F B
13. Which musk deer yield musk? . . . . M F B
14. Which honeybees are the "workers"? . . . . M F B
15. Which fireflies emit light? . . . . M F B
16. Which fur seals are taken for their fur? . . . . . . M F B

Correct answers on page 334

Minus Tail Feathers

Sirs:

At the feeding station in my window, one chickadee was definitely *boss*. In fact, he was dubbed Hitler, so emphatically did he dictate. This bird could not be mistaken for any other, not only because of his manners but because he had a dark streak like a scar across his pale breast.

In early March, Hitler suddenly appeared one day without a tail. In the blustery winds and the snow, he looked about as ridiculous as a man in shorts at a Christmas party.

In about two weeks a beautiful new tail was fully grown—but alas, in a short time only one feather of that remained, and in two more days he was again tailless.

Now he is sporting tail Number 3 and is as belligerent as ever. Is this a customary procedure in the molting season? If not molting, could he have lost *all* those feathers in fights?

Muriel Thomson.
Kitchener, Ontario

The following comments are offered by Dr. John T. Zimmer of the American Museum's Bird Department:

Miss Thomson's account of the chickadee's tail is interesting, although the experience is not uncommon among birds.

There is every possibility that the bird's tail became frozen to its perch during one of the cold nights, so that it was pulled out when the bird attempted

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to depart in the morning. Such occurrences are not at all rare. A fight with another bird or a near escape from a predatory cat could have been the cause, but considering the weather at the time and its repetition shortly thereafter, I believe the first explanation is the correct one.

When the bird is healthy, feathers lost by accident are promptly replaced, at least up to a certain point. The limitations have not been determined for the vast majority of birds. In fowl, it has been reported that the regular body plumage can only be replaced three times between periods of regular molt, but the primary flight feathers of the wing are less restricted. It would not be surprising to find the tail feathers also less limited than the body feathers since, like the primaries, they are of much more importance in the bird's existence. Nevertheless, they probably have a definite limit of exhaustion. Comparative figures on such details would make an interesting study.

It has been found that when the capabilities of a feather follicle, which is the cavity from which the feather grows, have been exhausted by repeated activities of this sort between molts, normal growth of a new feather nevertheless takes place at the next molting season. If the successive feathers are pulled out as soon as they grow, necessitating unbroken continuity in replacement, some breakdown of pigmentation appears to occur that does not happen when there is an appreciable interval. Full details of this and other interesting circumstances have yet to be established.

BOOKS

Continued from page 295

same one twice (pp. 13 and 566). Many of the photographs are uncredited and were evidently taken by Miss Pitt herself; others are by such talented bird photographers as Eric Hosking and G. K. Yeates. *Birds in Britain* opens with a passage from *The Canterbury Tales* and closes to the stately rhythms of *Paradise Lost.* All in all, enough poetry about birds is quoted to fill a fair-sized anthology.

This is an informative, if somewhat diffuse, volume. Every bird student will find much of interest in its pages, even though he is neither a beginner nor a resident of the British Isles.

Dean Amadon.

THE TWELVE SEASONS
- - - by Joseph Wood Krutch

William Sloan Associates, $3.00
188 pp.

FOR the author, the year begins more properly in April, and his "perpetual calendar for the country" begins and ends with Spring Peepers, as a sort of annual resurrection antedating the sources of Easter. And as each of the months brings changes in weather and in animals and plants, it suggests a train of thought relating man to the natural world around him. Throughout, Professor Krutch is impressed with man's unwillingness to consider himself just one of the living things, to say, "We're all in this together." The untidiness of Nature puzzles him, and he concludes that "the God who planned the well-working machines which function as atom and solar system seems to have had no part in arranging the curiously inefficient society of plants and animals in which everything works against everything else . . ." in a struggle that "goes on inconclusively millennium after millennium."

The neutral position of Nature in these struggles for survival seems particularly strange since man is so ready at all times to take sides. The author feels the futility of interference but notes a diminishing interest in doing so, a casual or negligent attitude toward life, as the size of the organism decreases. When confronted with single-celled animals visible only through the microscope, Professor Krutch finds himself wondering about his relationships to them. To him the discontinuity in size separates his activities from their worlds far more completely than from any possible men on Mars. No interplanetary travel can bridge the gap and allow him to understand their lives. Even among some things slightly larger, the same problem exists for him. "Two-

Answers to Quiz on page 333

1. MALE (it's his love song, some experts say)
2. BOTH (females' are shorter and less curved)
3. MALE 90% of time, but female has occasionally been heard to sing
4. FEMALE (male feeds on plants)
5. FEMALE with few exceptions, since they attain the salable length of 6", while males rarely attain 5"
6. BOTH
7. MALE
8. MALE (female replies with weak chirp)
9. FEMALE
10. BOTH (in all other North American deer, only males have antlers)
11. FEMALE (male seldom bites. It feeds on pollen and plant juices.)
12. MALE
13. MALE
14. FEMALE (but they're sexually undeveloped)
15. BOTH
16. MALE (but years ago, before present restrictions, both sexes were taken indiscriminately)

legged creatures we are supposed to love as well as we love ourselves. The four-legged, also, can come to seem pretty important. But six legs are too many from the human standpoint. Nothing that has them can be regarded with any sense of great intimacy."

The distinctive feature of life in the country around the year is not that "it is empty or that nothing happens, but quite simply that there is so much here which is not man . . ." The whole book stresses the importance of human kinship to living things as a guide in making man more humane, less machine-like, with warmer thoughts and stronger emotions. Faith in the future, in the return of the seasons, in the continuity of life and of man, is the essence that the author distills from observations near his Connecticut country home.

LORUS J. AND MARGERY J. MILNE.

Photo by Greuzemann, from Leon

▲ TAKE-OFF "in tandem": a remarkable action shot of godwits taking flight

OUR SUMMER WITH THE ESKIMOS

------- by Constance and Harmon Helmericks

Little, Brown and Company, $3.50
239 pp., 33 illust.

GOING to live in Alaska appeals to thousands of young people in the States, particularly those in the Northwest, as an adventure of the sort that our grandparents experienced on the American frontier during the last century. The few hundred who actually do go each year discover that Juneau, Anchorage, Fairbanks, or Nome are very similar to any small town "outside," and the jobs they must take to earn a living are no different at all. The Helmericks are representative of the small percentage who, having escaped from the United States Midwest and having been transported to Alaska (at a very high freight rate), actually do become acquainted with the country.

This book tells the story of a summer's experience in a fairly simple and straightforward fashion. They left the cabin in which they had spent the winter on the Alatna River, just south of the Brooks Range, and after some difficulties had themselves and a small outfit flown over to Umiat on the Colville. Here they assembled a canoe and with a small motor went down to the Arctic Ocean and eastward to Beechy Point, where they found a trading post and a small concentration of Eskimos. These people are the rather acculturated remnants of the fairly large population that once lived up the rivers that flow down to this north coast, and the Helmericks' incidental descriptions of their present customs and attitudes are the best parts of the book.

Misadventures building a sod house, trying to accumulate fuel for the winter, and acquiring an outfit of skin clothing are detailed. They went caribou hunting and sealing and made a trip to Barrow for supplies for the native store at Beechy Point. None of the mistakes that all strangers make in this exacting environment are glossed over, and the obvious honesty of this simple story recommends it. This is the second in a series of three books narrating the extended journey made by the Helmericks in northern Alaska.

JAMES A. FORD.

Winners of the Minerals Cryptomaze in the May issue of NATURAL HISTORY: The three contestants submitting the highest number of minerals listed in the main section (A-Z) of *Webster's New International Dictionary*—1948 (unabridged), in accordance with the rules of the contest, are: HAROLD EATON, Jackson Heights, N. Y.; DR. HENRY S. RICH, Bronx, N. Y.; MISS STELLA KRABBENHOFT, Sabin, Minnesota. Each of these winners has received a copy of the *Manual of Mineralogy*, by Dana and Hurlbut, published by John Wiley and Sons, Inc.

MUSEUM ANNOUNCEMENTS

Museum Expedition Leaves for Afghanistan

The first American archaeological expedition to Afghanistan left the American Museum of Natural History by plane on July 12 for Karachi, India. Led by Walter A. Fairservis, Jr., special field assistant of the Museum's Department of Anthropology, the expedition is seeking traces of what are believed to be some of the earliest cultures in the southern areas of Afghanistan near the Dasht-i-Margo, the fabled "desert of death."

The expedition will work in co-operation with the Afghanistan Ministry of Education in exploring areas that it is hoped will yield evidence of prehistoric cultures in Central Asia. According to Mr. Fairservis, these prehistoric cultures in Afghanistan may have been among the earliest forerunners of basic eastern and western civilizations.

This will be the first of a series of expeditions that may cover several years. The explorations will be divided into two general phases, consisting of studies of the Paleolithic period and the earliest Neolithic, ranging from 2000 to 3000 years B. C.

Mr. Fairservis is accompanied on the expedition by Louis Dupree, a graduate student in archaeology at Harvard University, and Henry W. Hart, an architect and graduate student at Yale University. Dupree accompanied last year's Peabody Expedition, which explored traces of prehistoric man in French caves. Fairservis did extensive archaeological work in Mongolia and China during the past war and has also worked on the famous Mongolian collections of the American Museum's Central Asiatic Expeditions. The expedition will also be accompanied in the field by several Afghan students, who will assist in excavations and will be trained in field study activities.

Special field equipment was sent ahead by boat, to be picked up by the expedition at Karachi. The archaeologists expect to remain in the field for approximately six months.

Expedition to Upper Amazon Tribes

Lewis N. Cotlow, whose previous explorations have taken him deep into the jungles of Central Africa and the Amazon Basin, is making his third visit to the Jivaro Indians (pronounced HEE-va-roe). This Ecuadorian tribe is popularly known because of its practice of shrinking human heads to the size of an orange. From Quito, Ecuador, Mr. Cotlow expects to travel to Cuenca to establish his operational base and thence into the territory of the Jivaros. He is accompanied by Jules Van Dyk Bucher, noted motion picture photographer, and expects to spend about six weeks in the Jivaro hinterland.

After a similar mission in Peruvian Amazon Territory, the party plans to travel down the Amazon from its headwaters to the sea, a hard and difficult journey of 3000 miles, of which the first 800 are the toughest. This journey will include a protracted stay among the Yaguas Indians. These, because of their long fiber skirts, were believed to be women warriors by the Spanish conquistadors and are the reason why the river was called the Amazon.

While the primary purpose of the expedition is to obtain motion pictures and still photographs of little-known Indian tribes, Mr. Cotlow hopes also to collect ethnological material for the American Museum. He expects to return to New York late this fall.

Donkey "Skeleton-in-Motion"

The final masterpiece of one of the great osteologists of the century, the late S. Harmsted Chubb, has been placed on exhibit recently in the Hall of Comparative Anatomy at the American Museum. This exhibit will rank high among the more than 30 other examples of Mr. Chubb's artistry on display in the Museum—creations that won him worldwide acclaim as the originator of truly artistic "skeletons-in-motion."

In this exhibit, a donkey is shown in the posture it assumed when fighting off the attack of a botfly by gnawing its hind leg with its teeth. It would be hard to imagine any position more difficult to depict accurately yet gracefully, but like all of Mr. Chubb's other masterpieces, this is a true work of art as well as a scientifically accurate representation.

Students of art, to whom anatomy is of such fundamental importance, have always received inspiration and technical enlightenment from Mr. Chubb's mountings.

Eskimo Life Portrayed

An unusual collection of photographs from the shores of the Arctic Ocean will be on display at the American Museum until September 7. The exhibit comprises approximately 45 pictures showing the influence upon the Eskimo of American and European contact and portraying the modern life of one community in northern Canada.

This remarkable series is the work of the Reverend Canon J. H. Webster, missionary of the Church of England at Coppermine in the Northwest Territories, Canada, who has spent 22 years in the arctic.

The exhibit, entitled "In Parka and Igloo," is made up of four groups of black-and-white photographs: People, Building a Snowhouse, Travel by Dog Team, and the Search for Food.

In the Planetarium

During September, visitors to the Hayden Planetarium will have opportunity to inquire into the mysteries of time and timekeeping, in a program entitled "Time by the Stars." The demonstration will explain how the astronomer checks his time by the stars, why our clocks and watches differ from sundial time, and other related questions.

Wildlife Poster Contest

Again this year the annual Conservation Poster Contest of the National Wildlife Federation will be held for contestants in all grades from the seventh through the twelfth in high schools. The contest will be divided into two groups, with a separate prize for each. Group No. 1 will cover all contestants in the seventh, eighth, and ninth grades, and the first prize will be $100. Group No. 2 will cover the high school grades through the senior year, and the first prize will be $250. The subject of the poster is: "Soil and Water—and Their Products." All entries must be received by January 10, 1950. Rules of the contest may be obtained by writing to the National Wildlife Federation, Washington, D. C.

Mammoth Cave Threatened

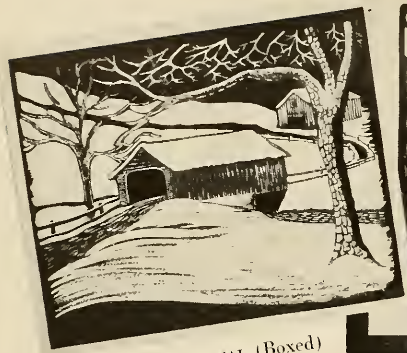
Kentucky's famed Mammoth Cave is seriously threatened by a proposed flood control dam across the Green River near Mining City, according to the Wildlife Management Institute. If the dam is built, periodic flooding will permanently damage characteristic geological formations in the cave, the National Park Service points out. Water level retention above 421.2 feet will cause flooding of both the Echo River and New Discovery sections of the labyrinth, and plans call for a maximum surface elevation of 450 feet.

The Mammoth Cave area was purchased by the people of Kentucky at a cost of millions of dollars and was presented as a gift to the people of the nation. Conservationists feel that the recreational and educational values of the cave cannot be replaced by artificial means and that the invasion of such an area by flood control and power projects is not consistent with the public purpose behind it. The National Park Service firmly supports this view, and the Secretary of the Interior has already protested vigorously to the Secretary of the Army against the construction of the dam.

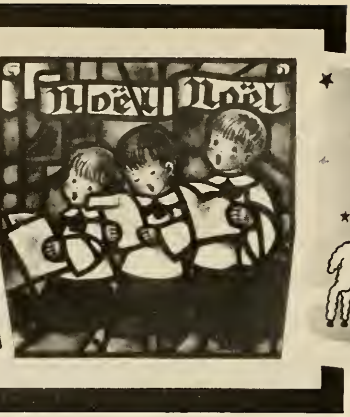
October **NATURAL HISTORY** *1949*

Fall of an Inca Fortress • Expedition Camps • Moles

Grass-Root Houses • Spider Monkeys • The Milu • Gulls



Workshop Traditional (Boxed)
12 assorted 50¢, postage 8¢



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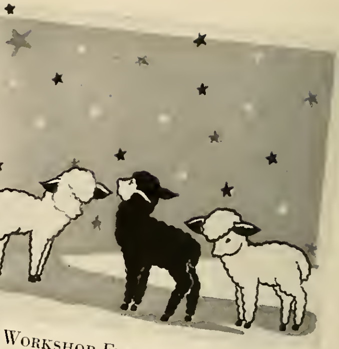


Workshop Fur and Feathers (Boxed)
12 assorted 50¢, postage 8¢

Christmas Cards

Workshop Select Assortment
21 all different Christmas cards
$1.00 a box, postage 10¢

Workshop Write Your Own Greetings
15 all different Christmas cards
75¢ a box, postage 8¢

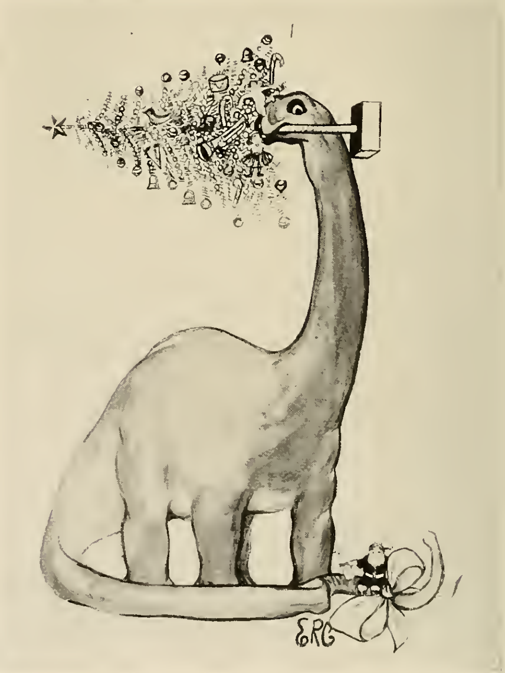
and Calendars

Alpine Scenic Calendar
12 beautiful photographic reproductions suitable for framing
$2.75, postage 10¢

Flower Calendar
12 photographs of flowers
$1.50, postage 8¢

Brownie Memorandum Calendar
A small desk calendar
50¢ each, postage 4¢

The Dinosaur Card, by Emmasita R. Corson
Printed in wine color, 10¢ each, postage 3¢ a dozen



The Book Shop

THE AMERICAN MUSEUM OF NATURAL HISTORY
77th STREET AND CENTRAL PARK WEST, NEW YORK 24, N. Y.

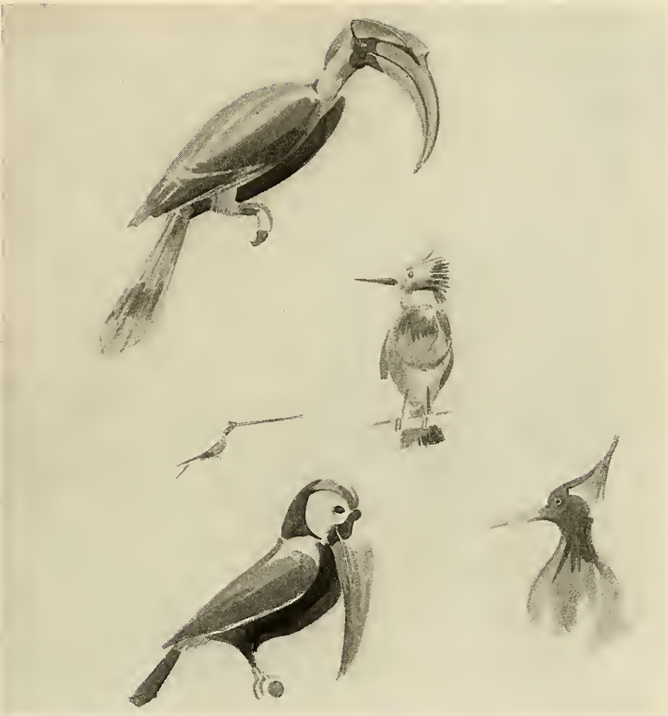
LETTERS

True Feel of Nature

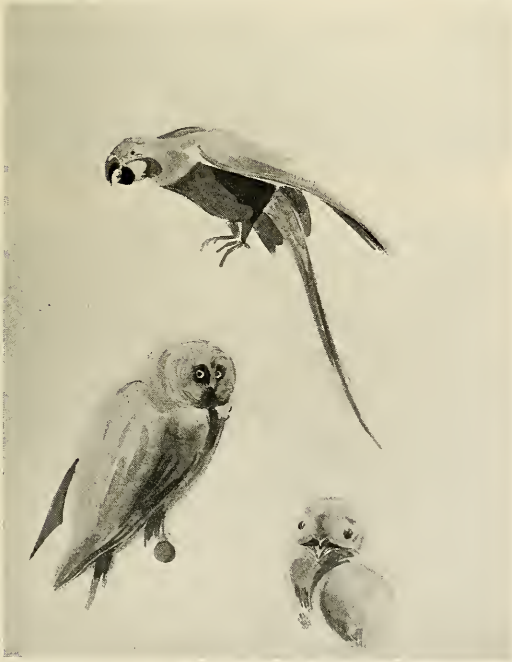
Sirs:

Like many out-of-towners, I thought for a long time that New York City had everything to offer except the true feel of Nature. That was before I came to the city and discovered that a dime's subway ride would deposit me in a jungle where hundreds of animals climb, leap, creep, and pounce—motionless behind their glass cages, each frozen into its own lifelike stance in its own natural habitat. Animals from every continent and from all the oceans, right in the midst of skyscrapers.

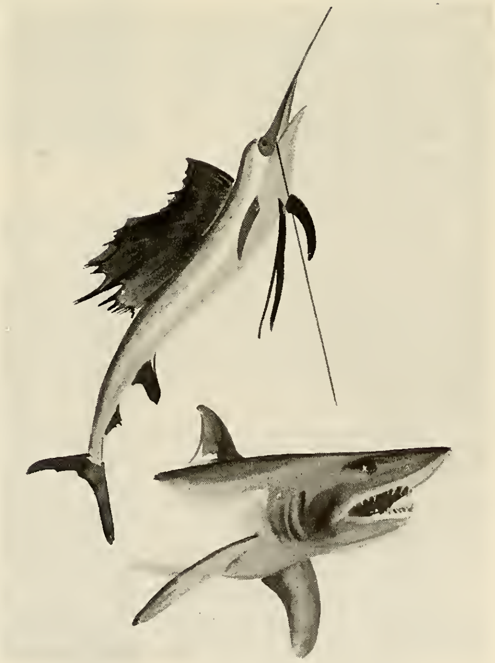
Recently, I decided to spend my few days of vacation doing animal sketching, and, naturally, I first searched the zoo for models. There I found plenty of material, but, believe me, the material did everything but pose. So I tried my luck before the glass cages in the American Museum. Not only did I find models that willingly posed for me in their most natural positions, but I discovered fishes, birds, and other animals that I had never known existed. And what amused me most (like a photographer who prefers "candids" of people rather than studio poses, I, too, wanted my models to "be themselves"), the animals, though stuffed, appeared to retain their special personalities. The ferocity of the shark is



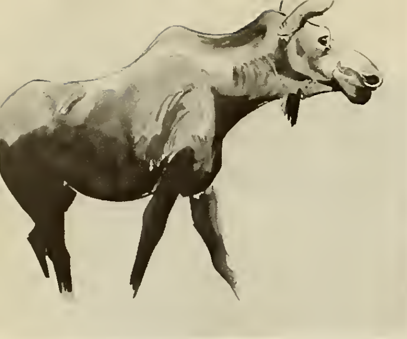
Great Hornbill
Hummingbird
Toco Toucan
Belted Kingfisher
Mexican Ivory-Billed Woodpecker



Gray Owl
Blue & Yellow Macaw
Great Potoo



Sailfish
Mako Shark (man-eater)



Moose (female)

written in its face. The male chimpanzee is a show-off, while his spouse regards him resignedly, obviously unimpressed by his uncouth antics. The aardvark totters about without a single opinion on important issues, while the pelican grins apologetically at its odd appearance. The cow moose, despite her size, is suffering from an inferiority complex. The lion, on the other hand, has no doubts about himself and looks about with contemptuous assurance. The elephant has a reputation to maintain and is trying hard to look wise, educated, and like someone who has plenty to say. The Alaskan bear surprised me; he seems to have a humble opinion of his place in life and manages to look quite gentle and self-effacing. The gibbons are completely unself-conscious, which is something you certainly couldn't say of the capybara. And so on. Every one of the animals appears with an individuality of its own.

When I finished these drawings, it occurred to me that, since they originated right in Natural History's own home, your readers might enjoy a few of them. Perhaps there are many like myself, who did not realize what fun there can be in sketching in this great museum. It is like traveling wherever you want to go. I felt like quite an explorer before I was through.

Stephen Baker.

New York, N. Y.

Artists can get folding chairs at the door, and there are thirteen acres of jungle and desert, sea and sky. Wheel chairs are available for "convalescent explorers." The American Museum of Natural History is open to the public every day in the year, and there is never an admission fee.—Ed.

Sea Monster

Sirs:

In October, 1946, I was notified that an odd-looking animal had been discovered lying on the beach at the southern tip of the Kenai Peninsula, Alaska.

Mr. William Renfrew, a local attorney, flew me to the spot in his float-equipped plane. The animal was eighteen feet, ten inches from tip to tip. The head measured three feet, six inches long and two feet, two inches wide. There were 22 teeth in the lower jaw and 20 in the upper. The actual tooth, when extracted from the jawbone, measured four and a half inches long.

An anthropologist from the University of Alaska made a special trip to view my pictures. However, he could not make a positive identification, and when he reached the place on the beach, a bad storm had destroyed all the remains except a part of the skull and the backbone. At no time could we find evidence of the rib structure. However, the anthropologist expressed the opinion that the animal was a species of killer whale. The question is still debated here in Alaska. Perhaps you can settle the argument.

Don Knudsen.

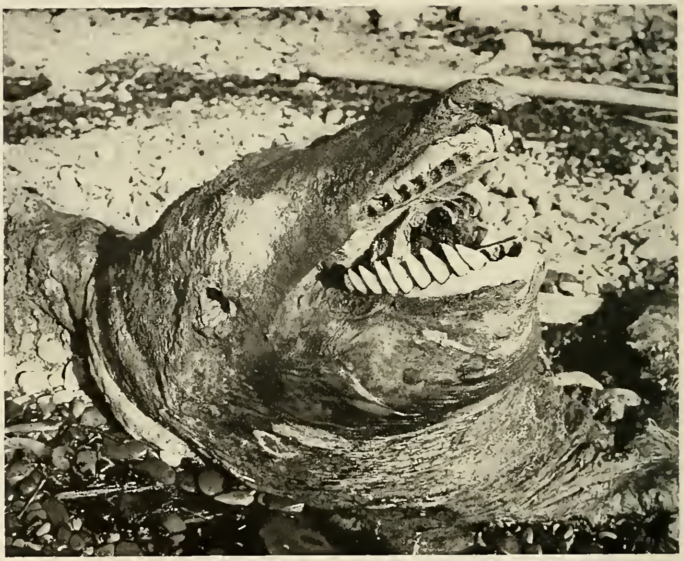
Anchorage, Alaska

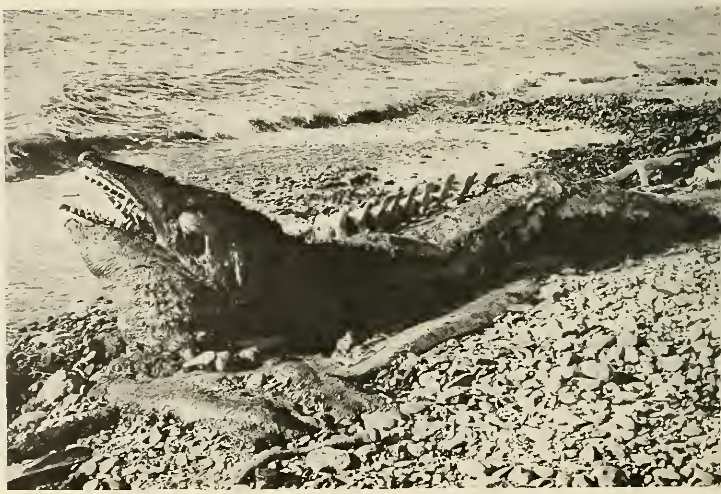
The following comments are offered by Dr. Harold E. Anthony, Chairman and Curator of the Department of Mammals at the American Museum:

It is not often that reports of sea monsters, of dubious identity, are as well documented as the one photographed and described by Mr. Knudsen. With such evidence as he supplies, we could doubtless find a suitable name even for the Loch Ness monster.

The animal beached on the Kenai Peninsula is the Pacific Killer Whale, *Orcinus rectipinna*, a giant member of the porpoise family. The large teeth and the size of the animal make the identity certain. Killer Whales are not uncommon in

Continued on page 382





NATURAL HISTORY

The Magazine of the American Museum of Natural History

F. Trubee Davison, President
Wayne M. Faunce, Vice-Director
In charge of Publications
Albert E. Parr, Director

VOLUME LVIII—No. 8
OCTOBER, 1949

Great Horned Owl...Cover Design
From a Kodachrome by Hal H. Harrison

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With the imagination of a Maginot, the Inca ruler built a series of forts that culminated in mighty Sacsahuaman

Spider Monkeys.................................Thomas M. Blackman 351
Their extraordinarily long, grasping tail figures prominently in their unsurpassed treetop acrobatics

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What man is earthbound, when a crumb for a bird can build a ladder to the sky?

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The mole is a confirmed "sand hog"; he even goes through the motions of digging in his sleep

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Its distinctive cry and the pattern of its wings against the sky will always thrill the fortunate observer

A Tree with a Maltese Cross...................Marie Copeland 381
Nature's inlay is more real and convincing than any handiwork man could create

You will find Natural History Magazine indexed in *Readers' Guide to Periodical Literature in your library*

THE COVER THIS MONTH

The Great Horned Owl is our only large owl with ear tufts or "horns." With its length of about two feet and wingspread of four feet or even more, it is our fiercest and strongest owl, and it is a formidable enemy of many woodland creatures. However, it draws most heavily on the ranks of the prolific rodents, including farm rats, and is valuable in controlling tree-girdling species like rabbits.

As early as February, the Great Horned Owl may be seen nesting, even when snow covers both nest and bird. It rarely builds is own nest, taking instead the nest of a hawk or crow, and it will protect its young with a ferocity that prompts the observer to approach cautiously. Like other owls, it hunts at night or at dusk, and especially in autumn its deep-toned hoots and blood-curdling shrieks provide one of the woodland's most eerie vocal effects.

The Great Horned Owl seeks shelter in dense forests and swamps and may be seen in suitable environments in almost any part of the United States. The color photograph reproduced on the cover was taken by Hal H. Harrison.

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YOUR NEW BOOKS

Geology • Mosquitoes • Conservation
Art and Scientific Thought • Jade

ART AND SCIENTIFIC THOUGHT

- - - - - - - by Martin Johnson

Columbia University Press, $3.00
200 pp., 16 plates

THE relationship of art to science, their complementary aspects of a whole, somewhat as the obverse and the reverse of a coin, seems possible as a thesis only in an age like ours. In the eighteenth century, when art was primarily representational and science depended upon the evidence of one's senses, the distinction between the two must have appeared more evident and beyond the need for reconciliation.

Dr. Johnson suggests that science has been frustrated in the past because of a failure to achieve a healthy relationship with art. Both are concerned with the communication of pattern, form, or structure. But where science builds on a logical basis and seeks to evoke in all minds a common and identical pattern, art may be fantastic and permit a variety of equally valid reactions. Even the contrast of the logicality of science and the fantastic in art, he suggests, is becoming blurred as modern science deals more and more with concepts beyond sense perception. One might comment on this notion by pointing out that the concepts of modern physics and chemistry are sense perceived by mechanical extensions of our senses and aim at the discovery of the real real behind the apparent real, quite unlike the modern aesthetic formulations of pure abstraction.

To illustrate his general thesis that science and art must be reconciled, Dr. Johnson presents first a series of essays on what he calls the fantastic or imaginative element in art. These include Beethoven's final quartets, Chinese jade carvings, Byzantine manuscripts, Gothic ivories, the Russian ballet, and the poetry of Walter de la Mare. In all these forms of art, structures and patterns are paramount. Their pertinence, however, is not always exactly striking, especially since no one is likely to contest the existence of form in these examples of art despite the highly individual interpretations possible of any one of them.

Following this, the author deals with several examples in the history of science of the failure of the scientific and the imaginative to maintain a healthy balance. The final section is devoted to an analysis of Leonardo da Vinci as a supreme example of a great spirit frustrated by the lack of a scientific sympathy in the age in which he lived. This analysis, as well as those of earlier periods of scientific frustration, are presented with scholarship and insight. The claims are interesting and novel, if not completely convincing. HARRY L. SHAPIRO.

THE STORY OF JADE

- - - - by Herbert P. Whitlock and Martin L. Ehrman

Sheridan House, $12.50
222 pp., 179 illusts.

ONE of the great disappointments of Mr. Whitlock's life was the unfortunate series of events that delayed the publication of his final work until after his death. We have waited many years for this capstone to Mr. Whitlock's American Museum of Natural History career as Curator of Minerals and later, as Curator Emeritus and Research Associate in Jade.

Mr. Whitlock's familiarity with jade came late in life, as he found himself thrust into the study of Chinese art and symbolism during the time of his acquaintance with Dr. Isaac Wyman Drummond, to whose memory this book is dedicated. He prepared himself well for the later gift of the Drummond Collection, which included many notable jade objects and contained many primitive-type ceremonial pieces, so different from the stylized and finished carving of the classical Chien Lung time. As his study of the significance of the carvings progressed, his interest became less mineralogical and more mystic. He read all that he could find on the subject, and he discussed the topic with authorities from other institutions. From this he evolved a very clear picture of the significance to the educated Chinese of the many figures that we find in the carvings.

Much of this lore he has placed in his final book. It is not of as much interest to mineralologists as it is to the collectors and lovers of fine jade carvings. In it are explanations of the traditions that impelled the artist to use this or that motif on his piece. And natural history is there in truth—depictions of the tortoise, the fish, the bat, the hare, the lotus, and the peach of immortality.

It contains so many scattered bits of Chinese myth and legend that it is not a book to sit and read; it is one to which to refer when some particular point is brought up or in which to find an explanation of some special combination of symbols. Besides, it is a handsome book, beautifully illustrated and nicely presented—truly, a worthy setting for the final publication of one of our curators of whom everyone was fond.

F. H. P.

A CONSERVATION HANDBOOK

- - - by Samuel H. Ordway, Jr.

The Conservation Foundation, $1.00
76 pp.

IN this little pocket book, a member of the staff of the Conservation Foundation sets forth his conception of the meaning of many of the terms that are in common use among conservationists. Organized into 10 chapters relating to as

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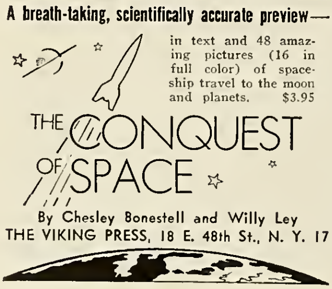

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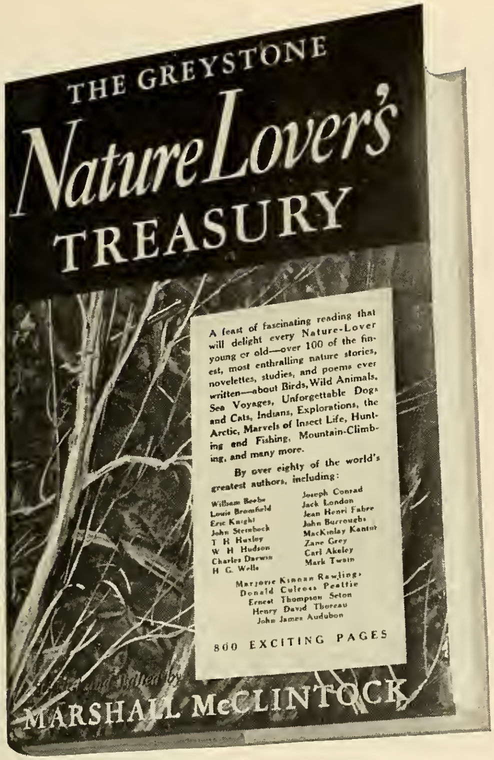
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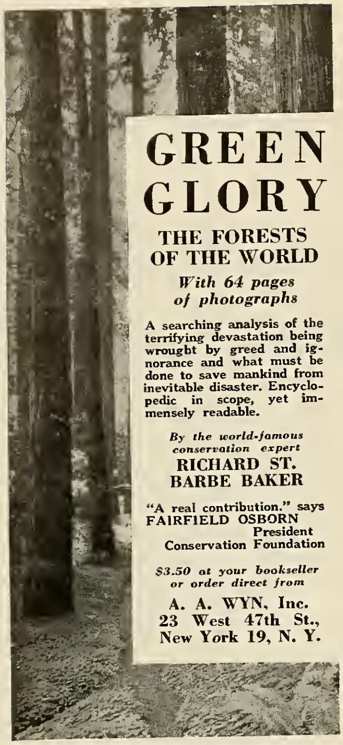
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HISTORICAL GEOLOGY

------- by Carl O. Dunbar

John Wiley and Sons, $5.00
567 pp., 350 figs., 17 illusts.

EVERYONE interested in natural history should have in his library information on the history of the earth and of its life. Here is a book that can be highly recommended for this purpose. It summarizes the whole subject, from the origin of the earth to the coming of man, in the light of the latest discoveries and with the unexcelled authority of the Professor of Paleontology and Stratigraphy and Director of the Peabody Museum of Yale University.

General principles are stressed, and the discussion is organized around these. The abundant illustrative details are drawn almost entirely from North America, bringing the story close to home for American readers and travelers. The numerous, carefully selected figures include magnificent photographs of rock outcrops and geologic features, restorations of a great variety of prehistoric animals, and 34 new maps of the inferred geography of North America at different times in the past. These maps represent in the main the last work of the late Charles Schuchert, acknowledged leader in this study. They ingeniously avoid appearance of knowledge where none exists by attractive use of clouds over marginal parts of the landscape.

This is a textbook for college courses in historical geology. It is a new book, but it succeeds and in part derives from the classic and time-tested Yale text, successive versions of which were written by Pirsson and Schuchert (1915), by Schuchert (1924), and by Schuchert and Dunbar (1933 and 1941). The success of Dunbar's new version for class use can be confidently predicted. Although not intended primarily for self-study, the book is among the best for anyone seriously interested in this subject. Such a reader will, however, also want more explicit direction for obtaining regional geologic information.

A set of color slides further illustrating the text is available from the publisher.
G. G. SIMPSON.

SPORTS FISHING BOATS

------ by S. Kip Farrington

W. W. Norton, $4.00
154 pp., 71 illusts.

SOONER or later this book had to be written. That it has been written and is now available to the sports fishing public is another creditable milestone in the progress of the author, who has in previous books shared his widespread angling experiences with others.

In the introduction to Farrington's latest publication, Michael Lerner calls attention to the popularity of angling throughout the world and describes the author as being eminently qualified to write about sports fishing, the boats, and other equipment employed in this highly interesting pastime. Mr. Lerner's stamp of approval, thus expressed, should be all that is needed to assure other anglers (if, indeed, such approval is needed) that the book is worthy of a choice place in their libraries.

One of the fine things about the book is the simple and straightforward manner in which it is written. From the beginning to the end, there is no doubt in the reader's mind concerning the author's knowledge of the subject he is discussing. Each chapter is complete in its details. There is no glossing over, and there is no pussyfooting. Farrington certainly calls a spade a spade. He tells why he likes certain boats and their equipment in a positive manner, and if he doesn't like certain other boats and their equipment, his statements are just as positive. He describes the boat that is ideal from his point of view. He tells of the thrill of catching fish from your own boat, and he goes thoroughly into the matter of choosing a fishing guide to operate your craft. He tells of his choice in fishing equipment, and he tells why he has favored it. He points out the pleasures that may be derived by combining cruising and fishing.

In other words, *Sports Fishing Boats* is a complete detailing of the subject, thorough and sound, authored by a sportsman who has, perhaps, fished in more boats and more places than any other living angler. It highly deserves a special niche in every sportsman's book collection. ERL ROMAN.

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WILD FLOWERS IN THE ROCKIES

------- by George A. Hardy
and Winifred V. Hardy
Illustrated by Frank L. Beebe

H. R. Larson Publishing Company
301 1st Ave. N., Saskatoon, $7.50
125 pp., 50 illusts.

THE freshness and delicacy of Mr. Beebe's treatment of his paintings is perhaps the first thing to strike one on opening this little book. The right-hand pages throughout are devoted to colored reproductions — four to a page — from Beebe's originals in water colors. For the flower-lover who wants to become acquainted with the form and appearance

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of wild flowers and has not too great a curiosity regarding their structure, these attractive paintings are just right.

The text to each set of four pictures is carried on the opposite page. On the wrapper the writing is described as "almost lyrical, giving the reader . . . a feeling of almost sensual pleasure." In an average of nine lines to the species Mr. and Mrs. Hardy, by abbreviating the purely descriptive parts to the utmost, contrive to leave themselves four or five lines for lyricism. And they do it well. Of the water knotweed, for example, they write ". . . Like little torches held erect above the surface, they flaunt their charms in undisputed rule among their kind . . ." Actual description is boiled down to "flowers" one line; "leaves," one line; "height" and "habit," one line shared between them.

The familiar plan of classification by color is adopted — a good enough plan when the color of the flower is unequivocal; but because of the vagaries of some species this method is not always satisfactory. In this book the arrangement is yellow, blue, pink to purple (which includes red), and white to green.

Wild Flowers in the Rockies really refers to the Canadian Rockies, with special emphasis on the flora of Jasper National Park and Banff National Park.

Some 200 of the approximately 500 species in the area have been portrayed. These represent 42 plant families. Such concentrated description naturally requires a glossary to explain the botanical names employed, and one is provided. There are also a brief list of references and indexes to common and technical names.

G. H. H. TATE.

THE NATURAL HISTORY OF MOSQUITOES

- - - - - - - by Marston Bates

The Macmillan Company, $5.00
379 pp., 16 plates, 9 figures

IN bringing together a summary of almost everything that is known about mosquito biology, Dr. Bates has rendered a distinct service to every student of these generally unpleasant insects, including students of medical entomology and those interested in public health. The question of mosquito control is not considered except for the natural control by their enemies, contained in a chapter on "Mosquitoes in Relation to Other Organisms."

Dr. Bates discusses the habits of the adults, including the time and distance of flight, their resting places, length of life, and the seasonal distribution. All of these show definite variation among the species that have been studied up to the present time. Many kinds of mosquitoes travel as much as a mile; a few travel farther; and some are much less explorative. The food habits of the adults are varied. Some prefer mammals of certain kinds, and man is generally not a preferred host. The wild four-footed animals of any region are the preferred hosts, but as a rule domestic animals, such as donkeys, horses, cattle, and goats, furnish desirable meals. Some kinds feed as readily upon Guinea pigs as upon donkeys, but others ignore Guinea pigs if other food is available. Some kinds of adults live only on the juice and nectar of plants; indeed, this is probably true of all male mosquitoes, although there have been reports of males sucking blood. In cases of this kind, it has generally been found that the biting "males" were hermaphrodites or gynandromorphs.

The eggs are generally distinctive, and close study of them enables the specialist to recognize the genus and very often the species. In *Anopheles*, the malarial mosquitoes, the eggs of each species are recognized especially by variations in the "floats," but other characters are also available.

The larvae, or wrigglers, all differ both in minute characters and in their habits and habitats. Most mosquito larvae live very close to the surface of the water, but there are some deep-living ones that obtain their oxygen from the stems of aquatic plants. Some prefer shade, while others like sunshine. They live in water wherever it is found, but none live in sea water. Holes in trees and the axils of plants hold enough water to produce mosquitoes adapted to that type of existence. The pupae conform to the larval habitat.

There is much about the diseases transmitted and more about the separation of species and races and the classification of mosquitoes. Laboratory and field studies, and the many problems posed by these phases of study, receive full attention, based upon the long experience of the author as a field officer with the Rockefeller Foundation in Europe, Africa, and South America.

This is essentially a textbook and reference, but it contains a world of knowledge, presented in an interesting and readable manner, so it will appeal to the layman who has only a slight interest in these pests.

C. H. CURRAN.

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THE SIEGE OF

By
VICTOR W. VON HAGEN

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▲ EACH YEAR, the modern people of Cuzco celebrate the traditions surrounding Sacsahuaman in the warrior's festival called *Intiraymi.* Here, in the great plaza fronting the fortress, one of the participants, personifying the ancient ruler, addresses his people. Sacsahuaman is unique among ancient American edifices in that the people today still remember the names of its architects

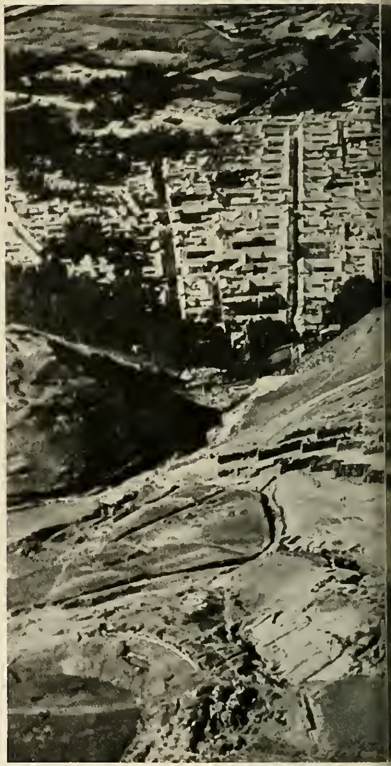


Photo by A. Guillen

▲ SEEN FROM THE AIR, Sacsahuaman clearly dominates Cuzco, the ancient capital of the Incas. But it was not designed to defend the city. It was a fortified refuge to be used in case of attack

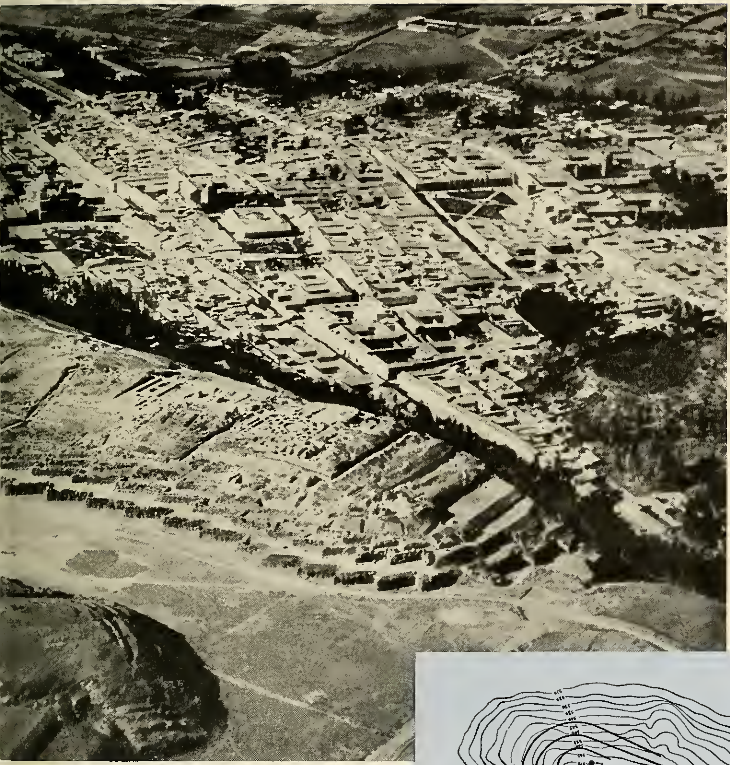
IN the heart of the Peruvian Andes, frowning down on the city of Cuzco, is the Inca Fortress of Sacsahuaman (pronounced Sacks-a-wha-MAHN)—one of the greatest engineering feats of ancient man. The immense rock masses of Stonehenge pale beside it; the tomb of Agamemnon at Argos and even the cyclopean walls of Agrigentum cannot compare with these gigantic stones, fitted together so perfectly in a mosaic of strength. Even the early Spaniards, preoccupied with their frenetic search for gold and so sated with marvels as almost to tire at the sight of a new one, thought Sacsahuaman the eighth wonder of the world.

One's first impression at sight of this fortress is one of utter astonishment. More than 1800 feet in length, covering an immensity of ground, built up to three tiers forming herculean walls—the spectacle produces wonder and amazement. How did these primitive Indians, without draft animals, quarry and transport these huge stones? How, with the dexterity of a Chinese artist carving a piece of ivory, did these people fit the irregularly-shaped rocks, some weighing over 200 tons, so tightly together that a knife blade cannot be driven between them?

Sacsahuaman was built to Guard Cuzco, the heart of the Inca realm. It would not defend the city from invasion but could serve as a refuge into which all the people of the city could retire in case of a general attack. But history had other ideas. The mighty fortress was destined to be stamped as more than an architectural wonder and to be singled out for bold pages in the drama of history.

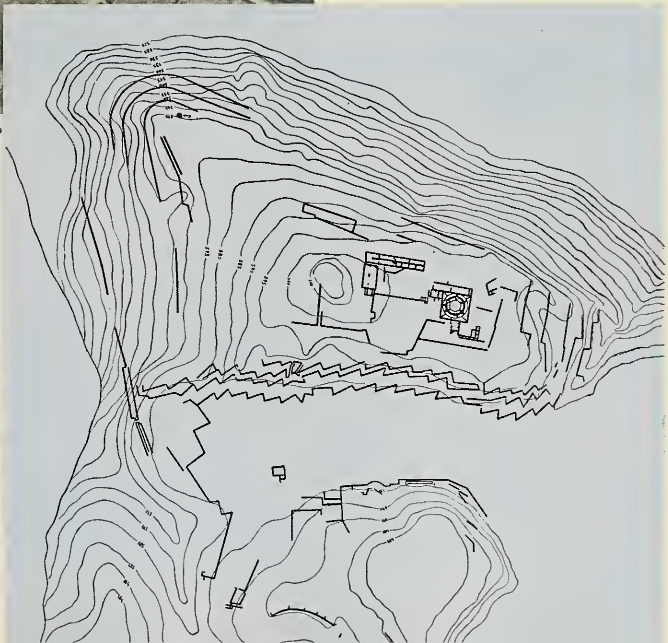
ACSAHUAMAN

With the imagination of a Maginot, the Inca ruler built a series of forts that culminated in mighty Sacsahuaman. No hostile tribe ever dared to assault it, but when the Spaniards came, history hung in the balance on its massive walls



Courtesy Archaeological Museum of Cuzco, copied by Aranjo

THE THREE TIERS of indented bulwarks, arly visible in the aerial photograph above, shown at right in ground plan, together h the other salient features of the fortress. te how the buildings on top are protected the side facing Cuzco by a steep escarpment



Sacsahuaman was begun some time after 1438, at the very height of the Inca empire. After years of determined conquest, the Incas controlled a rich territory from Cuzco southward, and the powers and wealth of the realm reached far beyond its borders. But subject tribes grew restless, and a series of revolts led the Inca Pachacuti ("Earth-shaker") to strengthen his empire's defenses and fortify border areas. There were very few walled cities in the Inca empire; valley towns were usually neither fortified nor defended. Instead each village had its fort, usually on top of a hill terraced and planted so that it could endure a siege. With the imagination of a Maginot, the Inca ruler built one fort after another, each growing more massive as Cuzco was approached. For his capital, Pachacuti conceived the Fortress of Sacsahuaman. It was his masterpiece.

The building of so complex a structure was assigned to professional architects. As they had no paper (they needed none, as they did not write) plans were probably first made in model form. Clay models for other buildings, terracing, and waterworks have been found. The Inca architects, who had a good eye for natural defenses, chose the craggy hill called "Los Altos de Sacsahuaman" for the fortification. Lying between the rivers or rivulets of Huatenay and the Rodadero, it rises abruptly from the valley and towers 700 feet above Cuzco. Its name was derived from a carrion hawk and meant metaphorically "Hawk Gorge Yourself," suggesting that, should an enemy try to scale its southern bastions,

▲ "The Inca Ruler," with a young Nusta, or "Woman of the Sun"

he would be dashed to pieces and become offal for the birds.

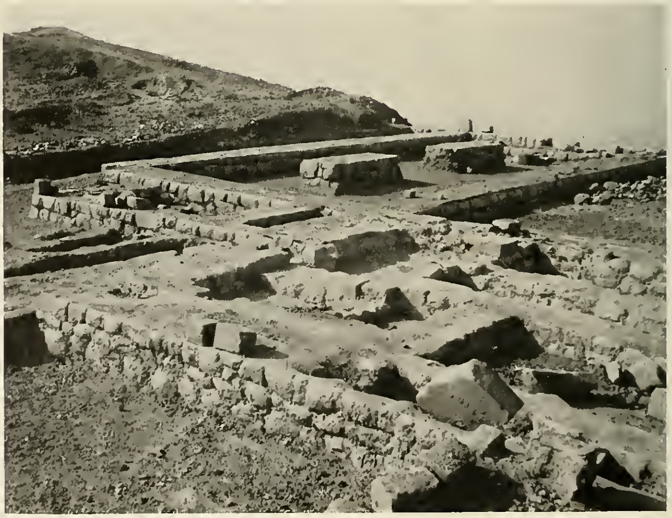
The tremendous amount of manpower necessary for such an enterprise was supplied by the *mit'a*, a primitive system of labor service by which each taxpayer was required yearly to give a certain amount of time to the state. Through this system, many thousands may at times have been at work on the fortress; and by the time it was completed, there was scarcely one in all the realm who had not had some contact with it, whose sons, brothers, fathers had not worked on it.

Much of the limestone used was quarried close by. Just north of the fortress, over the plateau, two graded roads to the limestone quarries are still distinctly visible; and within the quarry area, partly fashioned rocks can still be seen. All of Sacsahuaman, however, is not of limestone. When the Indian architect desired something unusually durable, he had the laborers drag huge polygonal blocks from quarries as far distant as 21 miles; this type of rock was used in the finest, most solid of Inca construction.

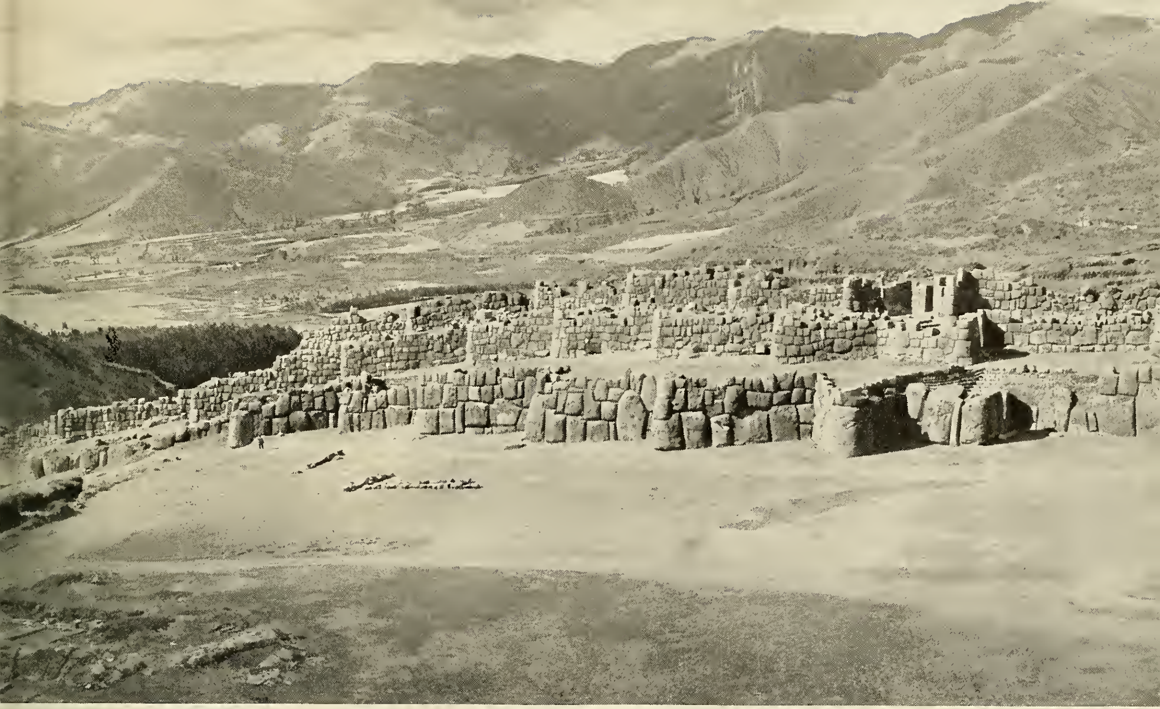
How did these Indians cut the huge rock masses and then move them overland? How did they move one of the greatest single pieces of the fort—a monolith 27 feet high, 14 feet broad, 12 feet thick, weighing upward of 200 tons? The answers can only be phrased in broad terms. As for tools, their principal and practically only implement was the stone celt, for despite the fact that the Incas and other tribes worked bronze, gold, and silver, they were architecturally in a neolithic, or "new stone age," stage of culture. For transporting the rocks, the Indians had neither horses nor oxen until after the Spanish conquest; the domesticated llama was capable of carrying only 75 pounds and was never used for draying. The stones were dragged by human power alone, pulled over wood or stone rollers by ropes made from the tough fibers of the agave. A ramp of earth was constructed to raise the burden to its appointed place.

Like certain other advanced Indians, the Incas slit huge masses of rock by drilling and inserting wooden pegs which, when wetted, swelled and cracked the rock. Also, they heated the stone with fire and then doused it with cold water, which also caused splitting. They finished and dressed the surfaces with celts of stone.

It is presumed that they worked from some sort of pattern. A workman would bring to the quarry the shape, more or less, of a desired stone, and a piece was selected that could be trimmed to the proper dimensions. This stone was then dragged to a designated spot, where it was cut, shaped, and dressed until all its sides would fit the other rocks about it, no matter how erratic the angles. Each stone was made slightly beveled on the face, and near the joints it was worked down sharply to the faces of the surrounding rocks. Time has, in some instances, altered this perfect alignment; weather erosion, earthquake, and violence have made some changes. Yet the edges are still wonderfully fashioned and cut with a precision that inspires the



▲ The foundation of one of the square towers, from which the Indians made their last stand in the siege of the fortress by the Spaniards over four centuries ago. It was near here that the Inca chieftain, seeing defeat certain, plunged over the battlement to his death



▲ THE SIZE of the three mighty bastions can be judged from the human figure in front of the lower wall at left

admiration of all who see them. It is almost impossible to conceive, without seeing it, the variety of shapes of these stones and the apparent facility of the Inca stonemasons in handling them.

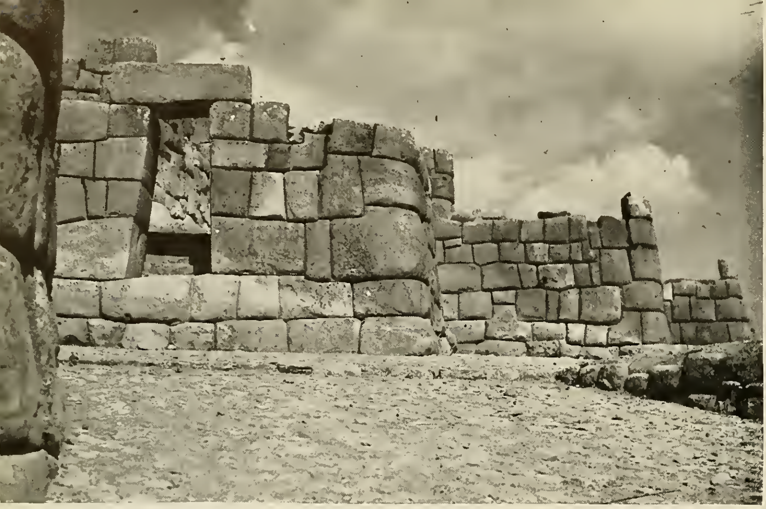
Year after long year passed while stones were transported and fitted together, and the raw materials grew into this structure of tremendous proportions. We don't know the exact date, but perhaps about the year 1508, 70 years after it was begun, there stood the greatest work the American native ever produced.

Facing the city of Cuzco, the eminence of the fortress presents a sharp, steep front, almost perpendicular, in itself almost impregnable. The Inca military architects, however, took no chances; on these heights they built three stone terraces, hard to scale, easy to defend. The principal fortifications of Sacsahuaman, facing directly north, dominated a huge flat pampa. Along this side for 1800 feet, almost ⅓ of a mile, ran a herculean wall composed of 3 massive lines, broken into 46 parts, each supporting a terrace and parapets rising to a combined height of 60 feet. It was not, of course, a solid wall but was cunningly built with salients, retiring angles, and buttresses, making it so formidable that no Indian enemy ever attempted its direct assault.

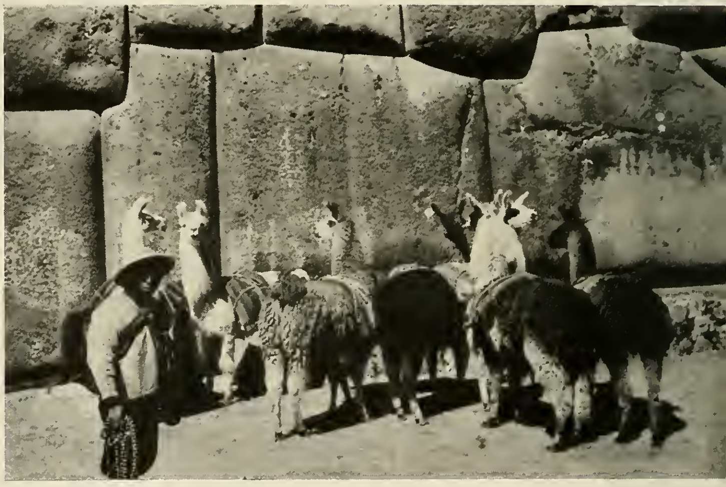
There were only three entrances to this huge fortress, three doorways only large enough to allow one man to pass through at a time, with one doorway for each of the

Photo by A. Guillen

➤ ON THE TERRACES below Salla Marca Tower are the ruins of the dwellings of the fortress refuge



▲ **The central doorway** leading to the third tier of forts, where only a few warriors were needed to hold off a body of the enemy. It was the forcing of this gateway by the Spaniards in 1536 that led to the fall of Sacsahuaman



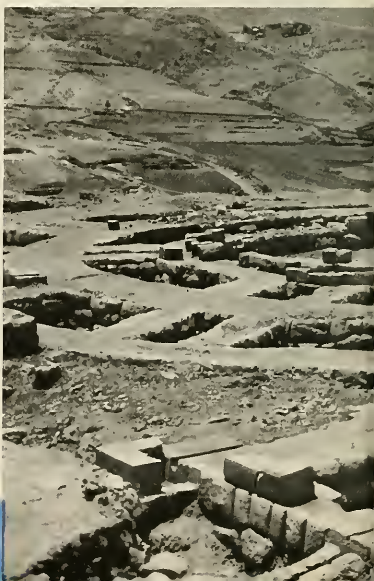
➤ **A flock of llamas** in front of the great walls of Sacsahuaman, showing by comparison the immense size of the blocks

three tiers. To enter the fort one had to pass through these or scale the sixteen-foot walls. The gates led from one parapet to another, through the sieve of defenses, to the top of the fortress where there seem to have been two square military towers, one at each end.

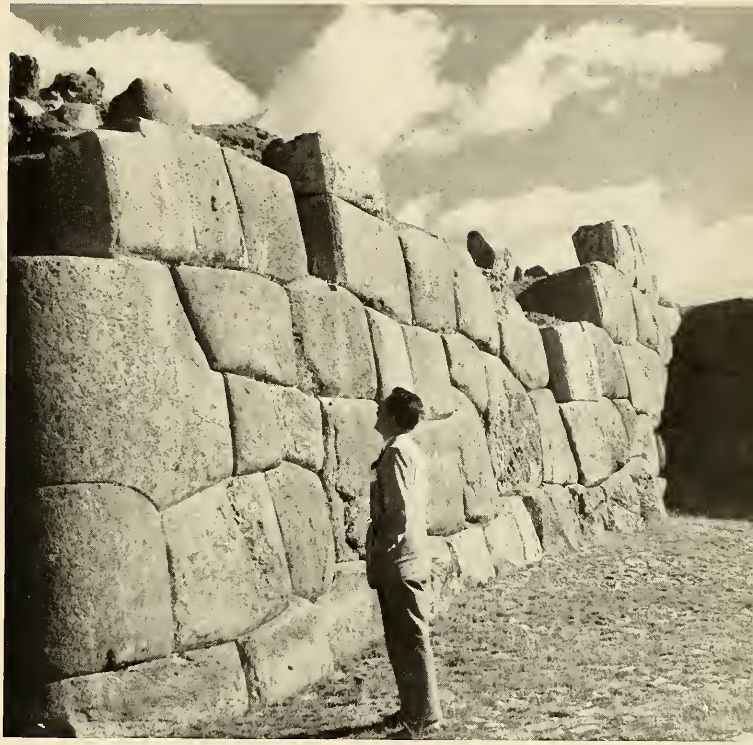
At the extreme east end of the fort, where the principal buildings were located, was the circular foundation of Muyu Marca. Although archaeologists disagree as to its precise functions, Dr. Luis Valcarcel, who excavated the structure, believed it to have been a reservoir, with a capacity of 50,000 gallons. It was still standing in 1560 when the Inca historian Garcilasco de la Vega left Cuzco for Spain, and he described it as a reservoir "of good water, brought from afar, under the ground." However, this chronicler often mixed fancy with fact, and his description has been doubted. How the water was brought up to the reservoir, which stands 50 feet above the plaza, still remains a mystery.

On the upper level of the fort, facing toward Cuzco, were the quarters of the commander of the fort and its soldiers, for Sacsahuaman had a permanent garrison that guarded the walls and kept in repair a great storehouse of arms—"bows, arrows, lances, copper axes, and cotton jackets," wrote a conquistador who saw them. In addition to the barracks for the troops, there were houses for the priests of the sun and habitations for the Inca and his principal officers—structures whose exterior walls were covered with gold, beaten and shaped into place in such a fashion that the stones looked more like golden ingots.

Sacsahuaman was, in fact, Cuzco in miniature, with its soldiers, priests, Nustas (selected women), and nobility in constant attendance. It was not, in a proper sense, a fortification; it could not prevent an invasion of Cuzco, for it commanded only one road, to the north. It was a refuge for the people in case of general attack, a place where sacred treasures could be stored and where the soldiers could withstand, if hard pressed, a siege for months.



➤ **The base** of Muyu Marca, which is believed to have been either a circular tower or a reservoir for water



▲ **The herculean walls** of Sacsahuaman show an intricate mosaic of massive stones, neatly shaped and bonded at the corners. The shaping of these blocks with stone tools and the transporting of them without draft animals inspire the modern visitor with wonderment and admiration

There are rumors, never confirmed by actual excavation, that the city was connected with the fortress by a tunnel through which the people could escape in case of assault. Such a tunnel, a half mile in length, cut through solid rock, overtaxes one's credulity; but in view of what the Incas did accomplish, some have accepted its existence. It is certainly true that the fortress was honeycombed with tunnels, high enough for soldiers to pass erect from one place to another. In these underground rooms, the Incas placed their trophies; here, too, they stored their golden objects against confiscation by possible invaders.

Even when one discounts the legends that have grown up about it, this mighty fortress, with its golden-plated buildings, its painted walls, its throngs of soldiers and nobles, must have seemed, to those who saw it at its apogee, one of the great edifices of Peru. Word of its marvels went even beyond the far-flung Inca borders and so deeply awed all tribal enemies that none ever attempted to attack it. Sacsahuaman was considered impregnable, and so it was until the white man came.

The conqueror Pizarro made his capture of the Inca Atahualpa in 1533, and the fabulous empire collapsed. Later the Spaniards poured into Cuzco, taking possession of the ancient capital and partitioning it among them. For two years the Pizarro brothers sat in the city, divided the wealth of the realm, and took over the Indians' functions, while Diego de Almagro, associate in the conquest, ever hungry for more gold, took off for Chile to search for his dreams. This division of the Spaniards left the city with only a small garrison headed by the three Pizarro brothers: Hernando, Gonzalo, and Juan.

On the night of April 18, 1536, the Indians suddenly rose in revolt against the white men who had usurped their empire and reduced them to slavery. All over Peru, at a given signal, the Indians attacked. They surprised men and women alike in this sudden burst of savagery.

The Spaniards were caught completely unprepared, for so sure were they of the docility of the Indian that most of their troops had followed Almagro to Chile. There were less than 200 troops left in Cuzco, many recovering from wounds, and of these only 78 were cavalry. In addition, there were about 2000 Cañari Indians who detested their Inca overloads and had thrown in their lot with the Spaniards.

The uprising was led by the Inca Manco Capac. Created Inca by his conquerors, he soon understood that he was a mere puppet. On the pretense of bringing a golden statue to Hernando Pizarro, he was allowed to leave Cuzco. Once out of the Spaniards' hands, he planned revolt and planned it well.

All the chiefs of the various clans were called to the war meeting. It was agreed that they would simultaneously attack Lima, where Fran-

cisco Pizarro had founded his capital, envelop Cuzco, and wipe out all the isolated Spanish outposts.

On the appointed day, the Peruvians converged upon Cuzco from four directions. They came in great masses, like swarms of locusts. How many there actually were we do not know, but the Spaniard, rubbing his eyes in astonishment, said there were 200,000. In an upwelling of sound, in which the harsh notes of shell trumpets mingled with triumphant cries, the Indians moved upon the city.

Within hours, Cuzco was a "sea of flames," according to an anonymous Spanish knight who was there.* Well did he remember the scene he describes, for in all the European wars in which his associates had participated there had never been a battle "so cruel and so pitiless." No quarter was given on either side. Because the roofs of Cuzco were of ichu grass and as inflammable as tinder, the city was soon ablaze. The Indians succeeded in the first few days in driving the Spaniards into the great plaza—Huakaypata. There beneath the light of the many fires, the white men were excellent targets for the missiles that rained down on them from the Indians at the base of the fortress. Death fell upon them night and day, and whenever one of the Spaniards had the ill luck to fall into the hands of the Indians, his head would next day be thrown back to his comrades, amid the constant rain of fire.

At the same time, the Indians attacked Sacsahuaman, killing the few Spaniards in attendance and disemboweling their Cañari vassals.

On the seventh day of the siege, the position of Cuzco looked hopeless. Couriers were sent to Chile to warn Diego de Almagro, but they never got through. Others were sent to Lima; all but one were killed. In Lima, Francisco Pizarro was having his troubles, too. The city was being attacked ferociously. Still, he managed to dispatch three relief columns to Cuzco. All, however, were decimated.

In Cuzco, it was chaos. The magnificent buildings the Incas had taken centuries to build were gutted, and those not destroyed were pulled down by the Spaniards to give room for their most effective weapon, the cavalry. But the Indians developed a defense against this, too. They put up an elaborate system of barricades and staked pits in the parts of Cuzco they held and outside the city limits.

For six weeks the Spaniards fought from house to house, retreating here, counterattacking there. It was a losing fight all the way.

Then fell a stunning blow, and it came from the mighty Fortress of Sacsahuaman, standing formidable and defiant on the heights of the city. From the base of the fortress the Indians fired every type of weapon they possessed – rocks, spears, fire bombs. The casualties on both sides were enormous, but every time a Spaniard was killed, it was as though 500 had died, so great were the odds against them.

It became obvious, we learn from our anonymous chronicler, that the Spaniards must either break the siege or perish. Hernando Pizarro, toughened by the interminable wars of Italy and not one to turn his back on a fight, talked to his men in the rough language of a soldier: "You see, men, that we are tired and worn, our horses galled. The fortress in the hands of the enemy is the source of all the danger that rains down on us. If we do not capture the fortress, we die."

So leaving a small force in the plaza, they split up into three assault forces and, with squadrons of Cañari Indians who remained loyal, they succeeded during the first days in driving the Indians back into the main fortress. They tried to force the gateways but were repulsed. Then, making crude ladders, they raised them against the great stone walls and from several sides began the assault.

Juan Pizarro, the youngest of the fighting Pizarros, tried on the third day to lead his group through one of the three doorways; but as he did not wear his helmet because of a head wound, he was struck by a propelled rock and fell mortally wounded.

His death only served to increase the exertions of the Spaniards. The Incas were consequently forced to send reinforcements, which our anonymous chronicler, awed by the immense numbers of Indians, put at 5000. With the reinforcements came a command from the Inca ruler that the fortress was not to yield. But as the Spaniards continued to press the attack—always at night, because the Indians loathed night fighting—the Indians soon expended all their supplies of spears and stones.

The center tower, Salla Marca, was the last to hold out. The fevered Inca resistance died with the Inca general. In the words of the historian Prescott, ". . . the Spaniards . . . overpowered the few combatants who still made a show of resistance. But the Inca chief was not to be taken; and, finding further resistance ineffectual, he sprang to the edge of the battlements and, casting away his war-club, wrapped his mantle around him and threw himself headlong from the summit."

The taking of the fort was the turning point of the struggle. Although the siege continued for 16 months, and 800 more Spaniards were killed, the Indians' attempt at reconquest was over. The final blow came with the return of Diego de Almagro from Chile with his great host of men; the Inca knew then that the test of strength had ended in Spanish victory.

A good part of Sacsahuaman was now reduced to ruins, and the capital city was rubble. The Spaniards removed most of the smaller stones from this great fortress, to rebuild Cuzco, and today Sacsahuaman is almost leveled to the massive rocks that form its bastion—an epitaph to one of the greatest battles ever fought in history. Yet, enough is left of this, the greatest engineering work of the American Indian, to imagine the rest. Broken but proud, the Fortress of Sacsahuaman remains as the early Spaniards wrote of it, ". . . greater than the bridge at Segovia or the buildings of Hercules."

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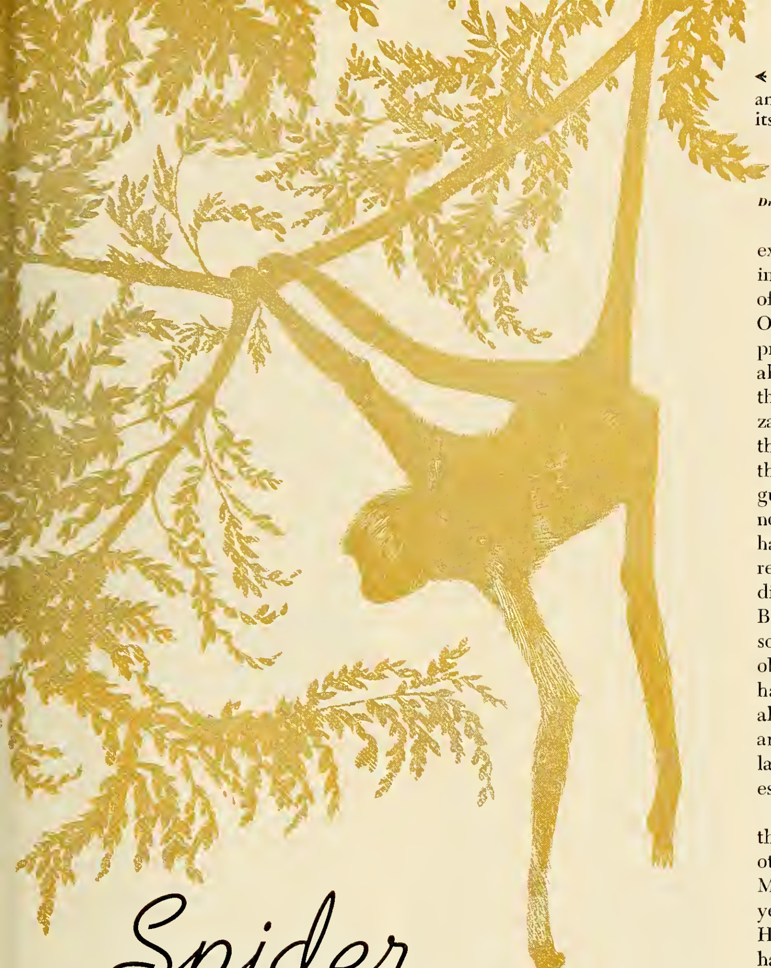
* Relacion del sitio del Cusco (written in 1536) republished in Lima in 1934, pp. 9-24.



◂ THE TAIL is longer than the head and body together. Toward the end, its lower surface is hairless and forms a very sensitive grasping organ—almost a fifth hand

Drawing by Museum Illustrators Corps

Spider Monkeys

Their extraordinarily long, grasping tails play a prominent part in their unsurpassed repertoire of treetop acrobatics

By THOMAS M. BLACKMAN

Photographs by the author

MONKEYS of all kinds are a source of interest to young and old. When seen in the zoo, their lively and tireless activity draws crowds around their cages; but when seen in their natural environment among growing trees, they present a far more interesting spectacle.

These animals are generally so shy and retiring in their natural state that even an experienced field naturalist finds it difficult to study their ways at close quarters. The exception is, of course, the monkeys in and around the cities and villages of India and other countries of the Orient, where they are regularly protected by religious custom and allowed to roam where they will—through gardens, streets, and bazaars—and frequently to pilfer to their heart's content anything in the way of food that they find unguarded. But monkeys that have not lived under such protection, or have, as in many countries, been regularly hunted for food or fur, display a very different attitude. Between these two extremes, we sometimes have the opportunity to observe the animals when, after having been kept in cages, they are allowed to roam with ample room among trees that are effectively isolated in some way to prevent their escape.

For such an opportunity to study the ways of spider monkeys, and others, I am indebted to my friend Mr. Frank H. Locey, who for many years owned a dairy ranch near Honolulu. The old Honolulu Zoo had been disbanded some years before, and all the larger animals had been disposed of, leaving only a few smaller ones and a collection of birds to form the Honolulu Bird Park. Due to his public spirit and interest in animals, Mr. Locey maintained a private zoo at his ranch for several years. He acquired an Indian elephant and three nearly full-grown chimpanzees from Mr. Christian R. Holmes' estate on near-by Coconut Island, as well as a Bactrian camel and several smaller animals, including monkeys of six different species. This compensated for the local deficiency to the satisfaction of hosts of Honolulu's children, who had free access to the zoo daily.

At one time a siamang gibbon was to be seen at Waialae Ranch; and for several months two spider monkeys, both females, were allowed their freedom in the trees surrounding the house and gardens. But most visitors to the zoo were not aware that this added attraction existed just beyond the fields of Napier grass, growing nine or ten feet high, between the house and the ranch buildings.

The spider monkeys remained there for several months, apparently quite contented with their lot, the only bar to their escape being the fields of grass surrounding them. They had the free run of a large Chinese banyan, two huge monkeypod trees, twenty tall coconut palms, and numerous smaller trees, including fig, mango, custard apple, carambola, and papaya. I need hardly say that they helped themselves to anything that took their fancy. They showed great partiality for figs and mangoes, and such fruits as they found edible seldom had a chance to ripen. These two monkeys quickly put an end to the nesting of house sparrows and ricebirds in the top branches of the large monkeypods in front of the house, but they were not aggressive toward birds that settled in the trees. Eventually, due to the cutting of some branches of the trees and the clearing of underbrush, the monkeys became alarmed, and next morning they were found to have crossed the surrounding fields to some trees bordering a roadway. There one of them came to an unfortunate end on some overhead electric wires, and the other was safely captured.

A while later two female crab-eating macaques were allowed their freedom in the same manner. By that time, the sparrows and ricebirds had rebuilt their eighteen nests in the two monkeypods, but the macaques quickly destroyed all the nests and apparently ate what eggs and young birds they contained. The monkeys then inspected the coconut trees, where there were nests of both myna birds and house-sparrows among the debris at the bases of the leaf stems. The monkeys were frequently seen to chase the birds out of such places. They would run along the midribs of the leaves until they swayed downward so much that it was even difficult for them to hold on. Meanwhile the myna birds would chatter and scream and fly around, making repeated swoops to within a few inches of the monkeys in a fruitless attempt to drive them from their nesting places.

The spider monkeys, of which there are a number of species, are indigenous to tropical America; and it is evident in many ways that they are more highly specialized for an arboreal life than any other monkeys. Their extremely light weight enables them to climb with ease among the thinner branches of the trees where an animal of only slightly heavier build could not follow. Their arms and legs are remarkably long and slender, endowing the animal with great reaching power; and the prehensile tail, though it varies in length somewhat in different species, is generally longer than that of any other monkey having a prehensile tail. So light and attenuated is the whole animal that on first sight it has quite a weird appearance, with its tiny head, pinched and shrunken cheeks, strangely elongated hands and feet, and extremely long tail.

When the animal is not asleep, its tail is always on the move, slowly coiling and uncoiling, ever ready to take a firm grip on any object within reach. It serves not only as a fifth hand but also as a safe anchor, which is always ready to fix to a passing branch whenever the animal needs additional support or even in case of a fall. The tail is considerably longer than the head and body, and toward the end its lower surface is sensitive and devoid of hair, forming a very effective grasping organ. It is sometimes used as a rope by which to swing while hands and feet are in use for the purpose of gathering fruit and conveying it to the mouth. It might even be regarded as the spider monkey's most prominent feature, for it attracts one's attention far more than does the little pinched face.

The tail is frequently used to grasp objects that are not within reach of the hands and feet, and it sometimes serves also as a life line while the animal sits dozing upon a branch high up in a tree, with the end of its tail twined around a thinner branch. But when there were no thinner branches within their reach, I sometimes saw these two monkeys, on hot afternoons, sleeping upon a thick horizontal branch in a more startling pose. Both were sitting lengthwise, one behind the other, each with its arms resting upon its knees, its head hanging forward upon its chest, and its tail curved upward, forward, and then backward, high above its head, in the form of a question mark!

In the tropical forests of South America large tracts of land become flooded annually in the rainy season; and it has even been suggested that this fact may have influenced the evolution of the prehensile tail among the monkeys and other arboreal animals of that continent. Such an explanation, however, is not without defect. To be sure, many of the monkeys of South America possess prehensile tails, whereas among the monkeys of other regions prehensile tails are unknown. And when leaping from tree to tree, monkeys are known sometimes to suffer accidents by falling to the ground. But after falling into a river, they have been seen to swim safely ashore. Actually, a fall into a submerged tangle of vines and other vegetation of a tropical forest might have more serious results.

Compared with other monkeys, spider monkeys are unusually quiet and gentle in their behavior; but they require ample room for exercise to exhibit their remarkable feats of swinging and leaping. Although fruits and nuts form their main diet, they search among the foliage for insects of many kinds. Those at Waialae Ranch appeared most to enjoy a large mantis, nearly three inches in length, which was sometimes quite plentiful. The monkeys often came down to the lower branches to take raisins from the hands of those whom they had learned to trust; and when offered a mantis they would snatch at it

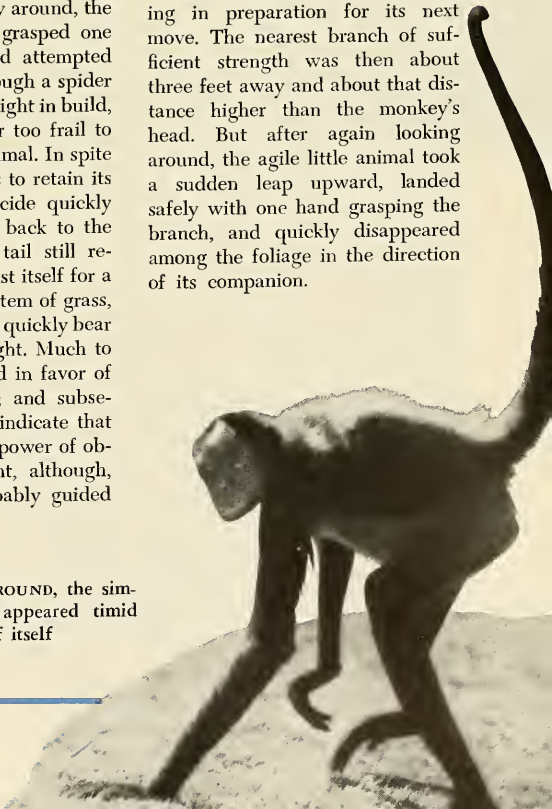
▲ Swinging confidently from its tail, the spider monkey uses its other members for gathering fruit or insects and conveying them to its mouth

quickly, as though aware that it might fly away. Taking it in both hands, they would hold it up and bite pieces from it at their leisure, in the manner of a child picking the wing of a chicken.

When at Waialae Ranch one evening I witnessed a demonstration of the agility and light weight of these animals. The sun was low in the sky, and as I sat looking across the lawn, its rays passed beneath the spreading branches of the great monkeypod trees and fell full upon the smaller fruit trees. While I admired the rapidly changing play of light upon the varied coloring of the foliage, I noticed a sudden movement in a small fig tree. A branch then bent downward, and the head of one of the spider monkeys appeared, raised high above the foliage to take stock of its surroundings. Again the branch swayed downward beneath its weight, and the monkey pulled itself onto a stronger branch, with its whole body now clearly in view. Then, climbing along the branch, it was able to leap to the next tree, and it quickly disappeared from view.

Almost immediately its companion appeared, and I watched it as it climbed along the same branch until the branch again bent downward, this time lower than before. That did not seem to please the monkey, which was evidently intent upon following its companion. The branch continued to bend, and it went so low that it dipped into some long rough grass. The little animal seemed desirous of avoiding this grass, possibly from an instinctive dread, possibly from actual experience, for most likely these monkeys had been caught wild, in a region where snakes or other enemies may have lurked. Our little friend appeared to be undecided as to its next move. It looked anxiously around, and its attention was drawn to three tall stems of Napier grass growing near by. The stems were still green and scarcely half an inch in thickness but reached high above the undergrowth. After again looking anxiously around, the monkey reached out, grasped one of the frail stems, and attempted to climb upon it. Although a spider monkey is remarkably light in build, the grass stem was far too frail to support so large an animal. In spite of the monkey's efforts to retain its balance, it had to decide quickly whether to pull itself back to the branch on which its tail still retained a hold, or to trust itself for a moment to the single stem of grass, which obviously would quickly bear down beneath its weight. Much to my surprise, it decided in favor of the single grass stem; and subsequent events seem to indicate that it showed remarkable power of observation and foresight, although, in reality, it was probably guided chiefly by experience. No sooner had it released its hold upon the branch than the grass stem began to sway over; but by a sudden movement the monkey grabbed another stem and pulled it until it crossed the one that was bending beneath its weight.

Although its fall into the rough grass now seemed delayed, the position of the little animal appeared little less precarious than before, for although the two grasses supported one another, both were now likely to sway over in either of two other directions, and the monkey still had a difficult task to maintain its balance. It seemed as far as ever from being in a position to make the upward leap into the small tree through which its companion had disappeared. Undaunted, however, it now reached out a hand and grabbed the third, and last, of the tall grass stems and pulled it across the other two. It then had, if not a firm support, at least a sort of tripod which might support its weight for a few seconds, provided it remained quite still. For a while it was motionless, as though resting in preparation for its next move. The nearest branch of sufficient strength was then about three feet away and about that distance higher than the monkey's head. But after again looking around, the agile little animal took a sudden leap upward, landed safely with one hand grasping the branch, and quickly disappeared among the foliage in the direction of its companion.



➤ On the ground, the simian aerialist appeared timid and unsure of itself

▲ THE DURABILITY of "grass-root" bricks is demonstrated by the old Isleta Mission, built before 1629 and still used as a place of worshi

The House That Gras

Some of the oldest houses in the United States were built of grass-root terrones, which required no molding or baking, and their cost is one-third that of adobe

By ALTON A. LINDSEY
Department of Biology, Purdue University

"I BUILD my house natural, out of grass and earth, like the world is made." The Spanish-American farmer was telling how he had grown the bricks for the family home.

Long stacks of these sod bricks, called "terrones," were piled in his front yard to dry in the intense New Mexican sunshine. They had been harvested from a terron field only two miles away, in bottomland along the Rio Grande between Santa Fe and Albuquerque. After several months' seasoning, the stacked terrones would be laid up in the wall.

The builder picked up a brick to point out the infinite number of small rootlets, in place as they had grown, firmly binding the heavy clay soil. The dried plant tops showed the roots were largely of salt grass and rushes.

"This is not what we call an

Barnes and Caplin photos from Western Ways

Built

adobe," he explained. "Those are made by mixing adobe soil with water and straw, then molding the mix in wooden forms. But a terron—the grass saves us plenty work! I cut these with a machine dragged behind a truck. The Indians near here cut terrones by spade; they have for hundreds of years."

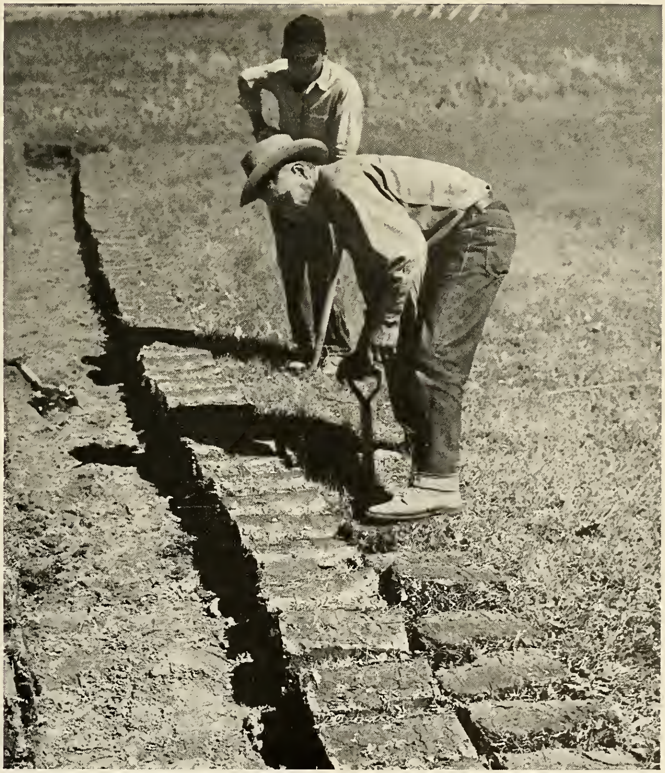
He turned proudly to the wall of his partly built house. Upon the standard concrete foundation he had laid up tiers of terrones to a height of three feet. The fourteen-inch length was placed the long way of the wall; the width of the bricks determined the wall's thickness as eight inches, before plastering. The terrones were inverted so that the grass tops could be nestled firmly into the mud between the bricks. Orthodox bricklayers using cement mortar playfully term it "mud," while the terron-user mixes authentic mud and calls it "mortar." I asked why he had poured an expensive concrete foundation but used common, garden-variety mud for mortar.

"Pull that wall down," he invited. Seeing my hesitation, he grasped the upper tier and vigorously tried to shake the wall. It failed to show the slightest vibration. The right mixture of mud is far superior to cement mortar, because it forms a better bond with earth bricks.

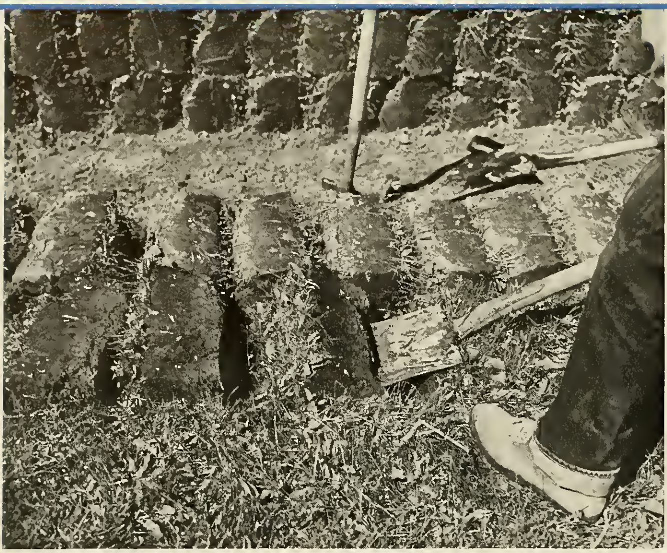
In moist sedge meadows bordering the middle Rio Grande, the natural vegetation consolidates the surface soil into a firm sod. The fields used for growing terron sod are reserved for that purpose alone, and not even grazing is allowed.

It is said that a young lady visiting a fur farm once asked: "How often can a fox be skinned?" The same question arises regarding a terron field, but the answer is different. After a layer of terrones has been removed, it usually takes about ten years for the plant growth to produce a sod suitable for another crop of terrones.

Indians of the Rio Grande valley probably originated the use of this unusual building material. Isleta Pueblo, fifteen miles south of Albuquerque, is constructed of terrones. Situated on a knoll beyond reach of floodwaters, the one-story houses



▲ BENNY GARCIA, an Isleta Indian, the only full-time terron cutter in the country. He uses the primitive spade method, though several part-time cutters have devised effective homemade machines that are dragged behind a truck



< **Close-up** of the operation. The broad-leaved plant is *Anemopsis* (yerba mansa); the narrow-leaved ones are *Juncus* (rush) and *Distichlis* (salt grass). These blocks will be used at Isleta Pueblo and Albuquerque

Barnes and Caplin photos from Western Ways

∨ **Nature's gift** to the Southwestern housebuilder: terrones stacked for seasoning

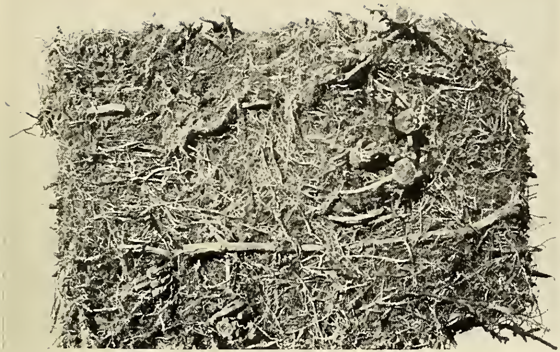
seem as permanent as the ground with which they blend so harmoniously. There is no reason to doubt that the oldest Isleta houses were standing when Coronado explored New Mexico in 1540—400 years of continuous use!

During the nineteenth century, terrones were more commonly used than any other building material in the Rio Grande bottomland villages and farms of central New Mexico. The wall of a barn north of Albuquerque, built about 1850, contains exceptionally large terrones. These can scarcely be called "bricks," as they are blocks of root-bound earth 22 inches long, 14 inches wide, and 9 inches thick. Two men were needed to cut and lift one of these giant terrones, and the structures built of them were massive and durable. This barn wall withstood the disastrous flood of 1874, which swept away buildings made of adobes and ordinary terrones, although terron houses are much more resistant to floodwaters than adobe houses. During the summer following this flood, some of the Spanish residents moved to higher ground and founded a new village, East Alameda, built of terrones cut from a near-by meadow.

Among the early Spanish inhabitants, a young man about to be married had no housing worries. It was customary for him to build a terron house for his bride, adjacent to his parents' home, using one wall of the latter as the starting point for the new dwelling.

Up to a point, the best terron houses are those built most slowly. Since terron walls inevitably settle somewhat, the builder should allow time for this as the walls go up. After each five or six tiers of bricks, he waits a few weeks before proceeding. Perhaps this helps explain the popularity of terron construction, as this leisurely building pace seems to suit the charming regional temperament.

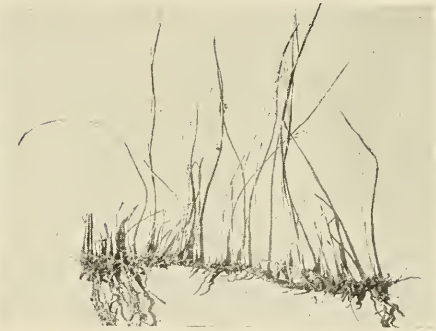
Nails driven into a terron hold firmly and do not damage the brick. This makes possible a novel method of applying plaster, whereby stucco netting may be dispensed with. The terron wall is densely studded with roofing nails before being plastered with modern stucco. However, an even simpler method is often followed. A mud "plaster" is applied over the terrones with no preparation; the projecting roots and dead grass tops serve to hold the plaster satisfactorily. Most owners replaster every three or four years. A good workman achieves a most pleasing and appropriate finish with his humble medium by relieving the plane surface with a network of broad, shallow fissures. The effect reminds us



Alton A. Lindsey photos

▲ **The skeleton** of a terron is the firm mass of interlacing roots. All soil can be removed from the brick by soaking, washing, and kneading, yet the plant material will still hold the form of the original block

▼ **A rush plant** removed from a terron which had been held firmly together by many such rootstocks and roots. The stout horizontal stem tunnels the sod



of the broad bark-plates of an aged western yellow pine and suggests that the house, like a tree, has grown up from the ground itself.

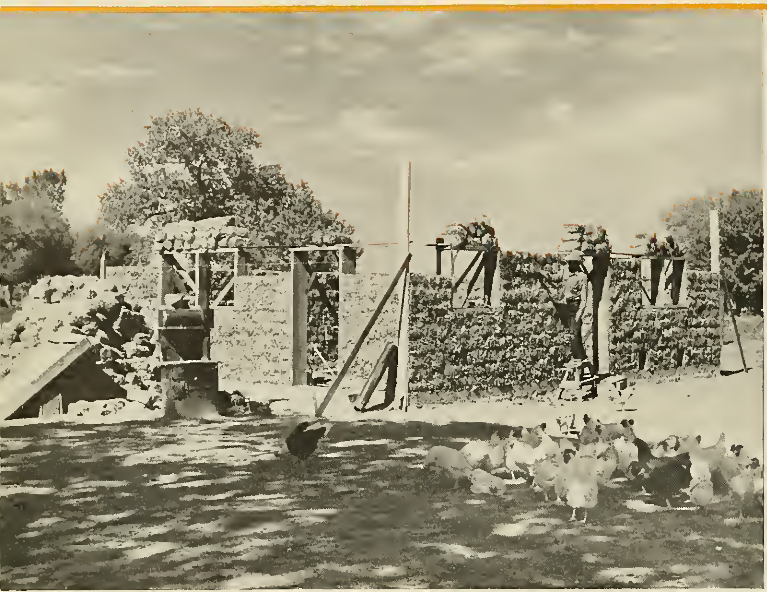
Plastering the outside is principally for the sake of appearance. In the dry climate of this region, there is scarcely any weathering of terron walls. Even unplastered adobes, which wear away a great deal faster, lose but one inch in twenty years, and this only where they are not protected by eaves. Many terron homes in the country, and most barns, are left unplastered. It is often possible to tell at a glance, while driving past, whether the bricks are terron or adobe. This is due to a color difference, the high organic content of terrones making them darker brown, on the average, than adobes. And if one stops to examine the house at close range, there need be no question which it is. A terron house shows the roots and rhizomes, and often the grass tops, in the inverted bricks.

The use of sun-baked bricks in arid lands of the world goes back to antiquity. To express the height of impracticability we say, "like making bricks without straw," and true to tradition, workmen in our Southwest invariably add straw in mixing adobe. Yet modern engineering tests have proved that the addition of straw or any other organic matter really weakens the adobes. Tests in a material-testing laboratory showed that straw decreased the compressive strength of the resulting adobes by 52 per cent! There is some temporary advantage in its use, however. At first straw apparently helps to hold the soft, moist brick together during handling and drying.

The strength of sod bricks is perfectly adequate for the one-story houses typical of New Mexico. Rarely, one sees two-story structures built of terrones. Compression machines show that the average terron is capable of withstanding a pressure of 194 pounds on each square inch of its surface. This is about equal to the average strength of adobes, which are three times as costly.

Barnes and Caplin photo from Western Ways

◀ **After** the top six inches have been removed for building blocks, Nature will automatically provide a new crop of bricks in about ten years



Barnes and Caplin photo from Western Ways

◀ WINDOW CASINGS are built right into the wall. After laying five or six tiers, the builder allows them to settle for a few weeks

The grass roots tie each terron together so well that an old terron building can be dismantled by prying the bricks apart with a crowbar. They remain undamaged and can be used again in a new house. This does not hold for adobes, however; they are completely ruined during removal from an old wall.

The best terron plants are those that spread by underground rhizomes and have profuse finely-branched root systems. Of all the plants in terron fields, salt grass best combines these requirements. Its horizontal subterranean stems, sometimes several feet long, have tough, sharp buds that can punch their way through hard adobe soil. Most of these rhizomes form a dense network in the uppermost three inches of soil. It would be hard to exaggerate the thoroughness with which salt grass roots and their myriad root hairs permeate the sod. The grasses are notable for the great branching of their fibrous root systems. An investigator found that one grass plant had roots with a total length of 387 miles! On these roots, this plant had about fourteen billion root hairs.

Another plant occurring in terron fields is the small rush, *Juncus,* whose massive rhizomes are beset with the bases of upright stems. The tiny spike rush makes up in numbers what it lacks in size. A few other sedges and grasses assist in building terron sod. The most conspicuous plant in these moist meadows is the least important one, the yerba mansa. This member of the lizard's-tail family has large white flowers and broad, plantain-like leaves. Its stolons creep along over the surface, and its thick vertical roots weaken rather than strengthen terrones.

Vegetation takes much longer to build usable terrones on a light sandy soil than on one with much silt and clay. In fact, a pure sand could probably never be sufficiently rootbound. Although underground stems develop remarkably, the small roots cannot become abundant.

Terron plants would perish if dependent on the eight-inch annual rainfall. They are all sedge meadow species with high water demands. During the six months of the growing season, a given area of salt grass loses twenty-four inches of water to the atmosphere. This is four times as much water as the same area receives from precipitation.

The water table is found high in the soil, where it is in balance with the water level of the adjacent Rio Grande. Both the river water and the alluvial soil of the bottomland have high salt concentrations. From the water table, moisture carrying dissolved salts rises through the soil pores by capillary action. When it reaches the soil surface, the evaporating water leaves behind the salts which form a so-called "white alkali" deposit. This contains the chlorides and sulphates of sodium and magnesium. Few plant species can survive such a high concentration of soluble salts, which makes it more difficult for the root hairs to absorb water. But the salt grass and other terron plants are especially suited physiologically to flourish under these conditions. The cells of ordinary plants are largely unable to absorb these salts; consequently, the salt solution around their roots draws water out of them. In contrast, the plants native to alkali flats and salt marshes permit the chemicals to enter freely through the cell membrane, which tends to balance the inner with the outer concentrations. Their inner tissues actually taste salty. In this way terron plants not only avoid losing their body water from the roots but are capable of absorbing the additional moisture they need.

The popularity of terron construction has declined greatly in this century, except for a brief boom during the recent war years. Due to the scarcity of other materials, many terron houses were built then, by families representing all three of New Mexico's population groups.

Years ago many Spanish-Americans made their living by terron cutting, which has since dwindled to the world's smallest minor indus-

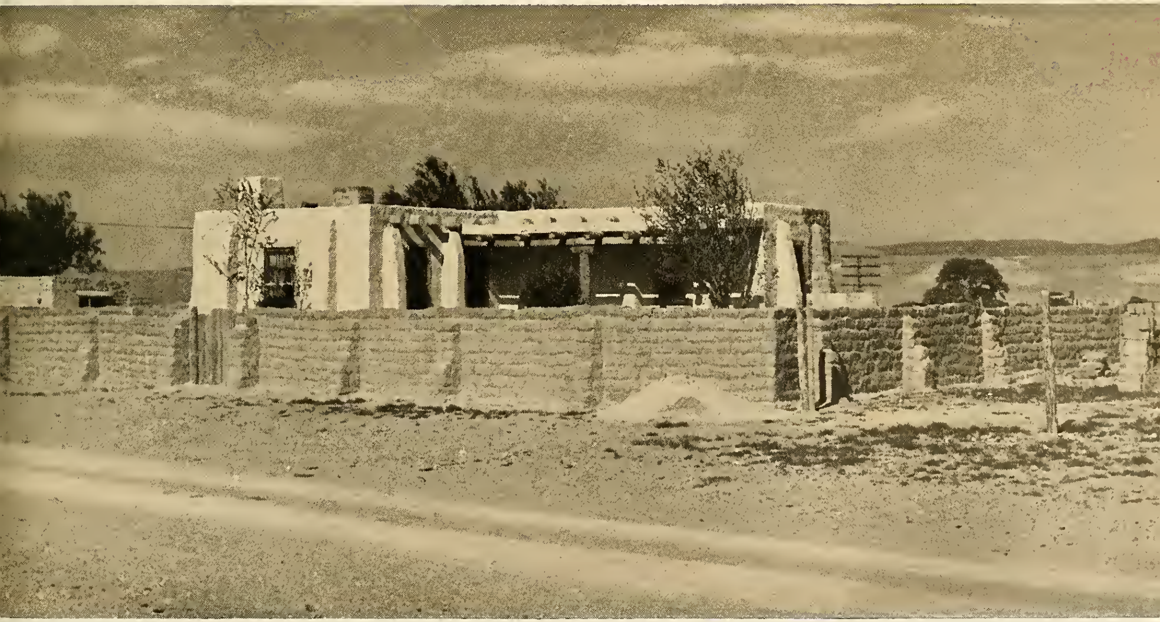
◄ Mud is used for mortar. Such a wall withstands rain and flooding better than adobe

Barnes and Caplin photos from Western Ways

try. An Isleta Indian, using the primitive spade method, appears to be the only remaining full-time terron cutter. The sight of him plying his archaic trade along the highway mystifies tourists, and they often stop their cars to find out what on earth is going on.

Most of us, on seeing our first unplastered terron house, are inclined to feel scorn for this inexpensive native material. This attitude is quite unjustified. Many large, modern terron houses, finished with stucco, are not recognizable as being of terron construction. No houses are cooler in the hot New Mexico summer or easier to heat comfortably in winter. It does not follow from these facts that earth is really a good insulator. Inch for inch, earth bricks have inferior insulating qualities when compared with wood and most conventional materials. But because of the very much greater thickness of terron or adobe walls, they give the greatest year-around comfort. From this standpoint, as well as availability and economy, the terron, in its proper setting, is a splendid natural building material for people "living close to the soil."

▼ A one-story house in Isleta Pueblo, New Mexico, built entirely of terrones. The wall has been left unplastered



Gulls over Santa Monica Bay

What man is earthbound, when a crumb for a bird can build a ladder to the sky?

By Ruth Dudley

Photographs by the author

. . . Their sun-lighted wings widespread

SEA GULLS are a common but ever lovely sight over Santa Monica Bay in Southern California, especially in the late fall and winter. You see them resting on the shore, their shadows glistening on the

. . . Shadows glistening on the dampened sand . . .

Toss a bit of bread into the air and they deftly catch it on the wing

dampened sand, or soaring gracefully through the clouds, their sunlighted wings widespread.

The California Gull with its gray back and wings and bright yellow bill is a prominent coastal visitor. The slate-backed Western Gull and the pearl-gray-backed Herring Gull are much in evidence, too, as is the red-billed Heermann's Gull.

In the summer many go inland to nest, so they're not so much in evidence. And since their food seems quite plentiful, they're more content to go their busy way. But from late fall through spring they grace our coast with their beauty, depending on small fishes for the mainstay of their diet. And when fish aren't too plentiful, they're eager, indeed, for any nourishing bits their many human admirers toss to them.

Go down to the shore with some food scraps and you'll soon see a beautiful sight. They'll probably spot you coming and circle around and around, curious to see what you have, eager for your offerings.

Toss a bit of bread into the air. Watch them spy it at once! In they come, circling cleverly, swooping gracefully. Deftly they catch a bite in midair or dart swiftly to snatch up stray morsels that drop to the sands.

Their wings make a soft rustling sound overhead as they jockey for position just above you. Their bright

In they come
swooping gracefully . . .
And more
and more of them

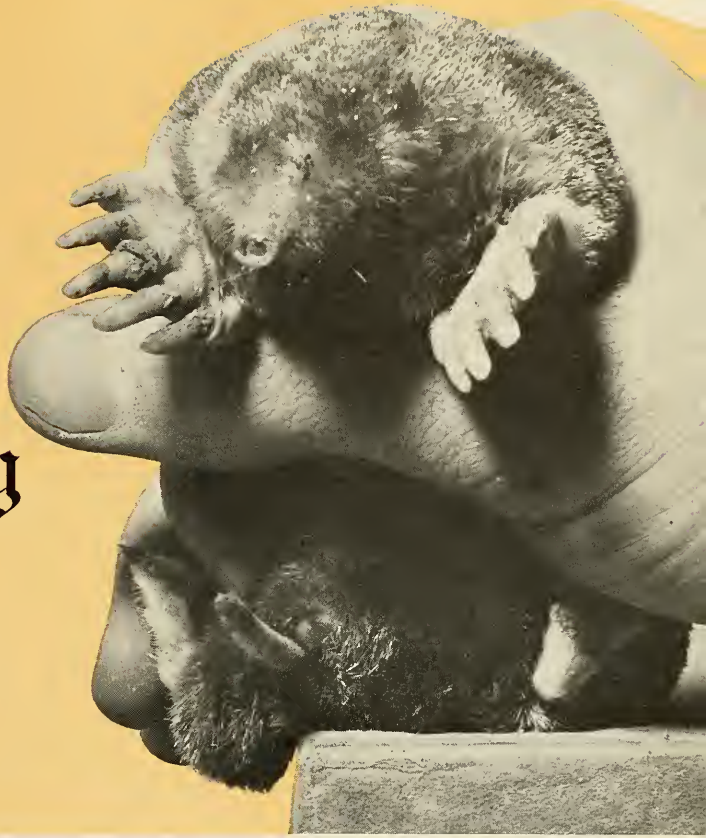
eyes, ever alert, miss no tiny crumb.

Closer and closer they come. They almost dart down to take bread from your hand—almost—but they're not quite sure of you yet. Perhaps tomorrow they will be.

Bread eaten, away they sail—away and away into the California sky. But if you linger there at all, if there's anything left in that sack, they're not fooled. Circling back over the seashore, they are instantly at hand to seek more—and more—and more.

It's a beautiful thing to see—the grace of these gulls—over Santa Monica Bay in Southern California.

So completely
is the mole adjusted to life
in his lightless labyrinths
that he
even goes through
the motions
of digging in his sleep



Little King of the Underworld

By Tom McHugh

All photographs by the author

▲ Nature's little "sand hog" depends on broad flat forefeet and strong claws. His eyes are almost useless. Kathryn and Byron Jackson have interpreted him as saying ". . . Night or day, rain or shine, it's all the same in a life like mine"

THE sod cracked and heaved upward. First one side and then the other of a small ridge were pushed up. Nothing stopped the work of this subterranean earth-cleaver as he forged on through the soil. Stalked plants fell over on their sides and small roots were torn apart with a faint crunching sound.

My curiosity could wait no longer, and I quickly plunged a trowel through the ridge to trap the animal in the blind end of his tunnel. But even that was not enough to corner him. By the time I had brushed away the top of the ridge, the only remaining sign of the creature was a patch of velvety fur and a little pink tail. I rapidly seized the tail and started pulling, but pulling on that organ was about as successful as trying to uproot a small tree—it just didn't work.

Finally, by removing all the earth around him, I succeeded in pulling out all seven inches of a gray furry mass. With its broad, spadelike feet and pointed pink snout, it gave every indication of an animal that was truly "king of the underworld." Few animals have become as specialized for a narrow existence as this common mole.

Putting the mole on a hard-surfaced dirt road was ample proof of this. Completely ill-adapted to walking above ground, he traveled over the road with an awkward waddling gait. The ungainly stride was obviously due to the fact that his legs extended out to the sides, rather than beneath him.

When I placed him on some looser soil, he immediately sought a path of escape. Rather than waddle off into deeper grass, he quickly put his nose to work at finding weak spots in the ground. Placing his forefeet close to his snout, he pushed the earth aside. Again his nose became active, not in boring or in shoving aside the dirt, but in discovering a suitable spot to place the feet for the next side stroke.

In less than a few seconds he had completely vanished from the upperworld and its attendant bright colors and pleasant breezes. He had disappeared into a world of damp earthy smells, perpetual darkness, and sounds little stronger than the weak grating noise made by an earthworm inching along through its tunnel. The mole's life is one of blind confinement.

Like most animals that dwell in undying darkness, the mole has very poor eyes. Scarcely the size of a pin head, each one nevertheless contains all the elements of a normal eye. But most of these elements have greatly degenerated, and the mole can probably do no more than tell lightness from darkness.

In the lightless chambers of his underground home, however, the mole needs no vision and no apology. With his naked snout and small pink tail he perceives the earth about him. Both structures are densely covered with sensory cups and tactile hairs. Running from these to the brain, a network of nerve trunks conveys the vital messages. When the mole is backing up in his burrow, the tail serves like an eye in the back of his head. In going forward, the nose is never used for loosening the soil. Rather, it makes rapid and detailed examinations in order properly to direct the powerful claws.

Of course, the mole's ears are also very valuable sense organs. Since big external ears would rapidly become clogged with dirt, the mole has none. Instead, two little skull holes lead into inner organs of hearing that are powerfully developed.

Besides the ears, nose, and tail, other modifications adapt the mole to its subterranean life and complete the story of this remarkable specialization. The fur is velvety and offers scarcely any resistance to the animal's passage within the tunnels. The neck is so short that the forelegs seem to sprout from the sides of the head. With this arrangement, the mole can bring his forefeet together in front of his nose for excavating earth from the end of the burrow.

The big, flipper-like forefeet are the very essence of his moleness. The claws of the forefeet are broad and spadelike, and in digging they are pushed against the earth like so many shovels. Compared with the rapid digging of an animal like the dog, the mole is slow indeed. Unlike the dog, the effectiveness of the mole's claws is not due to the momentum gained before they strike—rather, it is due to the great muscular force with which they are pushed. The large size of the forefeet makes them an adequate base for the enormous claws and gives them a large capacity for transferring piles of loose earth. Even the hind feet are webbed to kick earth through the tunnels.

Although these adaptations have been known for some time, their exact method of use for digging was long a mystery. Since moles do not expose themselves at the surface while burrowing, field studies could give only general ideas concerning the animal's movements.

Naturalists long believed that the mole could easily "swim" through the earth, much in the manner that a person glides through the water by the breast stroke. It took some clever experiments by Dr. F. L. Hisaw to prove that "swimming" was not the usual case.

Dr. Hisaw constructed boxes with glass sides and bottoms so that the burrowing creatures could be watched from the side and from below. In this way he found that progression was, to be sure, made by a swimming motion if the soil was loose. But if the soil was packed until it was as solid as that normally found in nature, the mole did not "swim," but dug.

The digging is done entirely with the forefeet. The way in which these are used can be demonstrated by placing a mole on a table and holding it down with the palm of the hand. The mole might be expected to resist this force by raising its body and struggling out, but it

▼ A MOLE HILL like this at the surface indicates where the mole has been digging a deep tunnel and has pushed the dirt up into a pile

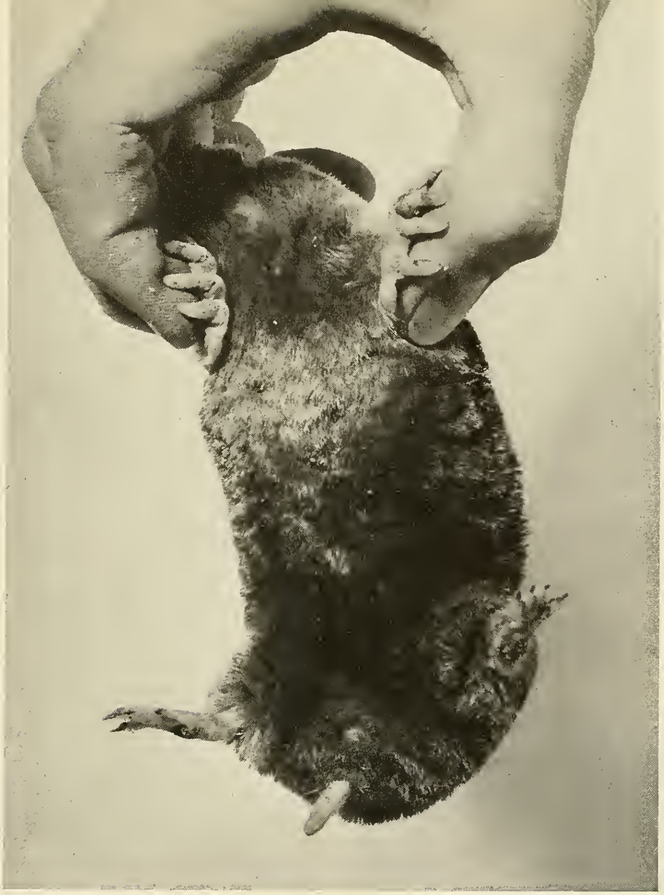
▼ IF YOU poke a stick into a mole hill, you will find a soft place into which the earth falls to the tunnel system below. The mole later plugged the hole shown here

does not. Instead, it rotates its body, puts one forefoot on the table and the other against the hand, and pushes with a slow but strong motion.

Moles use the same type of movement when they are excavating their surface runways. One foot is placed on the floor of the tunnel while the other pushes the earth up to form a ridge. The sod is thrown up on the right and then on the left and in front. There is every appearance of industrious work as the mole presses forward at the rate of about 12 to 15 feet an hour.

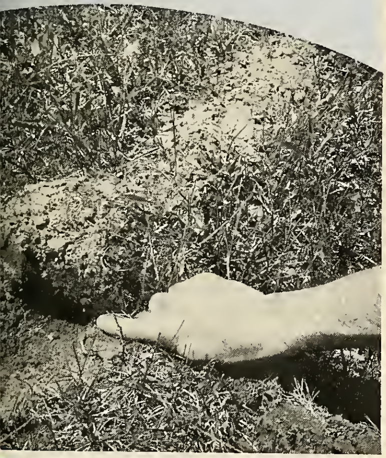
Besides these surface runways, which are used for collecting food, moles also dig deep passages that are used as headquarters and for thoroughfares to feeding grounds. The deep tunnels may be from six inches to two feet below the surface of the soil.

At this depth the earth cannot be pushed upward or to the side. Instead, it must be loosened and carried away. After a quantity of dirt is freed and piled in the tunnel behind the mole, the animal turns about and pushes the earth out of the burrow with one of its broad paws.



▲ **AN AVERAGE MAN would have to lift 4800 pounds to equal the strength of a mole. It can exert 32 times its body weight in this position, with forefeet thrust against the thumb and fingers of the hand**

A SECTION has been cut through the sur- ce runway to show how the earth has been lit and pushed up to form the tunnel



As the soil is forced up through the entrance, it falls down on all sides and forms the familiar mounds that we call "mole hills." Sometimes this earth may be packed into a discarded part of the tunnel system.

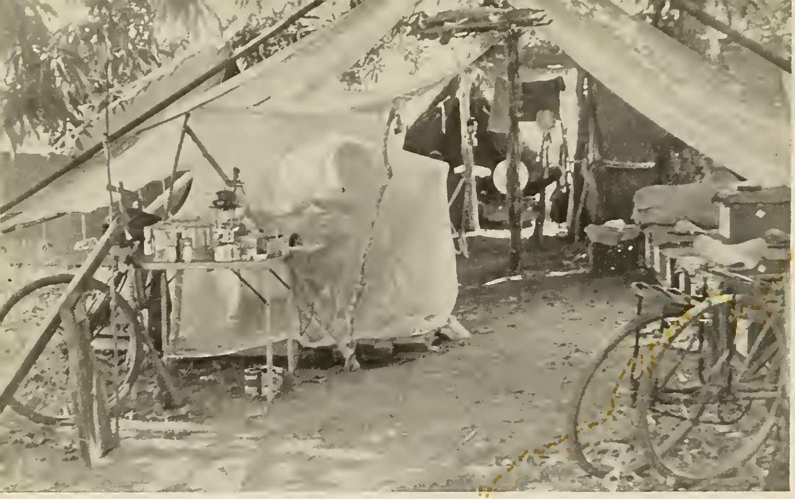
Like most people, moles eventually become discontented with their homes and begin remodeling. Whereas human beings rebuild their houses for better appearance, the mole does so for food. As the mole remodels, he drives a new tunnel beneath the old, pushing the earth into the discarded burrow above.

This seems to be a clever way of saving labor. The remodeling is obviously for the purpose of feeding on earthworms and insect larvae, which require moist earth. If the animal were to construct an entirely new system deep enough to reach this food, he would not only have to break the hard dry surface but would also have to remove much earth to reach the proper depth.

Since these tunnels are a vital defense against predators from the outer world, breaks in them are rapidly repaired. Soon after a rupture occurs, a little pink snout appears and cautiously explores the opening. The snout is quickly withdrawn, and, within a minute, the break is plugged with a mass of soil.

Moles even use their digging habits to capture dangerous prey. They have been known to force

(Continued on page 383)



◄ MOBILITY is inherent in the entire equipment represented in this camp at Lockerbie, near the northern tip of the Cape York Peninsula. George Tate is seen at work on his collection under mosquito netting. The bicycles were useful in collecting where roads or paths existed

By

L. J. BRASS

All photographs by Archbold Expeditiions

Camps on Cape York

Fortune and misfortune in Australia's northern no man's land: vignettes conveying the true essence of expedition life

CAMPS are more than temporary stopping places to the expeditioner. They are important focal points in the memory of those who travel off the beaten tracks. One does not, in retrospect, go directly back to the mountain ridge where some new plant was found or to the exact spot where a rare mammal was trapped. It is from camps as local points of orientation that the mind's eye carries one back over the trails of the years. That is so with me, at any rate.

On the Archbold Cape York Expedition in the spring and summer of last year, we lived in camps as varied in associations as they were in kind. We camped by the sea and on the mountains, in the sodden gloom of rain forests and in fire-swept open country. Some of our temporary homes had such unorthodox amenities as floors underfoot, a stove for the cook, and even a shower bath with running water. Others were thoroughly primitive and had little to recommend them for comfort.

The most wretched camp on the trip, and I think in the whole of my experience, was high on the east slopes of Mt. Bellenden-Ker, more than halfway to the 5200-foot summit. We found its name, Tick Camp, not at all fitting, when with two local men, Bill Kerns and Sven Nielsen, Dr. George Tate and I climbed the mountain in April and stayed there two memorable nights.

"Water, water everywhere . . ."

We knew that mountain would not be easy. We had been told stories of men who had cracked up on the long climb and had to be helped to Tick Camp and water. The Bellenden-Ker area, with 160 inches of annual rainfall on the coastal sugar-cane lands below the mountain and perhaps well over 200 inches at high elevations, is the wettest part in all Australia. Moisture-demanding rain forests cover the slopes and formerly occupied most of the now cultivated lands below. But so rapid is surface runoff on the very steep sides of the mountain that lack of water is a difficulty expected by the occasional parties that make the climb. The only sure camping supply within 3000 feet of the summit is at Tick Camp. There, clear cold water can be dipped from pools in the granite sand of a gully head crowded with graceful *Orania* palms and tree ferns.

Scarcity of water would not be one of our troubles, we felt, as we set out from the cane cutter's barracks we were using as a collecting base. The weather had been rainy. Streams coming down from the mountain had roared in spate every night; and early that morning, for the first time in four days, we had seen the main peaks exposed through the white clouds that had been hanging over the summit ridge. If we had any misgivings, they were about our gear, which I'm sure would not have been approved by an expedition outfitter back in New York. Most of our equipment was on a ship strike-bound down the coast, and we were making shift without it. We

➤ A "GAMMON" SHOWER approaching on the strong southeast wind that blew day and night at Newcastle Bay. The camp was situated on the sand dunes behind the low trees at right

⮟ CROSSING the peninsula toward Newcastle Bay, the truck became stuck in a boggy gully. The fallen tree was one of many blown down by a cyclone

⮟ GEOFFREY TATE and some butterflies he caught at Newcastle Bay. He collected reptiles and amphibians, as well as insects and other invertebrates

had no tent or fly, nor could we have carried one in any case. Food, bush knives and a tomahawk, cameras, a blanket, and a change of clothing apiece were as much as we could tote, besides papers and boards for collecting plants. George and I were rather proud of packs we had fashioned from "Sugar Mixture" fertilizer sacks found in the barracks. Bill had his Australian army pack and ground sheet—relics of the New Guinea campaign. Sven carried his things in a 70-pound sugar bag — the Australian Bushman's holdall. Both wore the shorts and shirt that are practically uniform garb in that tropical part of the country, and for ease of travel, Swen went barefooted.

Starting out along grassy headlands of the cane fields, we entered the deep shade of the rain forest by a path slashed through a bordering raspberry thicket. Then, after crossing a little stream where we paused to cut helping sticks, we began to climb by a faint old trail marked by stubs of cut undergrowth and here and there by a blaze on a tree.

The Bamboo Zone

● The first 1400 feet of slope was very steep and hard going. Footing was bad on a clayey soil left wet by the rains. The morning sun, quickly gaining strength and shining on the treetops, set up hothouse conditions in a forest much entangled with lawyer vines and a climbing bamboo. Lawyer vine is a name facetiously applied by Australians to climbing rattan palms of the genus *Calamus*, the thin stems of which are used for cane furniture. From their prickly leaves hang slender thongs of tendrils armed with hooks as unyielding in their hold on clothing or neck or ear as the grip on clients of the fabled gentlemen of the law. The inch-thick green stems of the bamboo, hanging from the trees and sprawling in loops on the ground, were nuisances in other ways. They made a perfect slide when trodden on unwarily. When cut, their sharp ends often caught our shins or whipped across the trail to snag our packs.

Above the bamboo zone the forest became fairly open underneath and the gradients temporarily less steep. The sky by this time had clouded over, the air had become cooler, and we had gotten our second wind. There were places where the big white flowers of a rubiaceous shrub filled the forest with a delightful, gardenia-like fragrance. This shrub occurred only on the crest of a spur ridge, where, with increasing altitude, a mat of exposed surface roots formed a soft brown covering on the ground. Traveling a bit farther, we stopped at a trickle of water in a gully to boil the tea billy and eat lunch. We had climbed about 2000 feet.

Mist now hung in the treetops, quieting the birds, which up to then had been busy and noisy enough, though not conspicuous. In the stillness, broken only by the soft crackling of our fire, the moving things of which we were most conscious were leeches. From a safe seat on cut leaves of a fan palm, which the blood-hungry pests could not cross without being seen, we watched them standing on end, an inch or two high, on the leaves and twigs that strewed the ground, leaning and wavering sensitively in our direction and looping their way toward us.

Early on the climb, Sven and Bill had often stopped to scrape one off a foot or a leg with their knives, then grimly bisect its extensible and remarkably tough, dark body against a tree or rock. George and I, with trouser bottoms stuffed into tops of socks, and legs well rubbed with carbolized soap, were not so much bothered, although all four of us were bleeding somewhere from the attentions of the loathsome things. One had been discovered as it attached itself in a corner of my mouth. Another had crawled into my shirt and escaped notice until I felt an itching, burning sensation under my right arm, where oozing blood was slowly coagulating. Investigating at my belt line, I found the enormously distended leech that had dropped off after its feeding. The blood from the bites was kept flowing for a time by a secretion from the mouth area of the leeches, which retards coagulation—and attracts other leeches. Sven's bare feet were a horrible sight by the time we stopped at the lunch camp, and Bill fared only slightly better. The tender skin of a war wound on one of his legs was a favored place for attack.

Tick Camp

● So far, apart from the annoyance caused by leeches, we had done well enough. But as we shouldered our packs to go on, rain began to fall — cold rain that soaked us through and added weight to our poorly protected loads. No one had much to say, even about the increasing leech pest, until the end of a hand-and-foot struggle that brought us to the crest of the main southern spur of the mountain at 3100 feet. From there on, up and down along the narrow crest, the going was easy, and I was glad of it. My legs were beginning to give out when a dim shape, with horizontal lines blurred by rain, showed ahead in the forest, and Bill inquired, overcasually it seemed to me, "What do you think of it?"

There was nothing imposing about Tick Camp. If conditions had permitted me to take a picture of it, you would have seen just a few patches of charcoal where campfires had burned, a rusty can or two, and an open, very leaky little lean-to shelter thatched with palm leaves. The shelter stood in tall forest and faced out over the edge of a precipitous slope that dropped off into the clouds. Bill and Sven had built it on an Easter visit two weeks before. The poles of its frame were tied to living saplings with split lawyer cane, and a few still green leaves lay spread on the ground for a floor.

In the pelting downpour, our guides went after more palm leaves to enlarge and improve the shelter, while I started to light a fire. Under the roof, a stick of green ghittoe had thoughtfully been left hanging. Ghittoe (*Halfordia scleroxyla*) is a tree of the rue family, common in the mountain rain forests. Green or dry, its timber, bushmen swear, will burn under the worst conditions. This would not. Nor would dead ghittoe. I split the yellow, oily

➤ HOBART VAN DEUSEN serves dessert at Newcastle Bay. Joe McLaughlin, the cook, is on his left and George and Geoffrey Tate across the table

◄ CAMP by a quiet water hole in open forest near the Jardine River, on the far northern part of Cape York Peninsula

▼ THE EXPEDITION lived in this World War II radio hut at Iron Range. The thick rain forest in the background was rich in plant and animal life

wood in slivers thinner than a match and arranged them above the wet ground on flat-split billets. Still it would not burn. Wooden safety matches, carried in my oiled-silk tobacco pouch, would strike, but that was all. Their stems would not burn as kindling, nor would so-called waterproof wax matches, which would not even strike. The fibrous inside of rotting lawyer canes, which the rain forest aboriginals use for starting fires, was tried without success. Newspaper from the plant presses took up moisture so rapidly that the paper itself would not ignite, let alone set fire to the wood. And the rain kept pouring down. It dripped and trickled through the roof of what was now a fairly roomy hip-roofed shelter, with eaves down to the ground. It drifted in the ends of the shelter as ground spray, and water seeped up from the trodden, peaty soil.

Of necessity, the fire-making job became a problem for all hands. Wet, chilled to the bone, tired, and constantly pestered by leeches, we tried every trick we knew. Our puckered hands shook so with cold that it was hard to strike a match or arrange the slivers under the drip-proof shelter of Sven's wide felt hat. Finally, after efforts lasting a full two hours and a half, by means of a bit of waxed paper that George remembered he had in his pack, we got a fire going. And when it did burn, it filled the shelter with pungent, choking ghittoe smoke, which drove us out into the rain to wipe streaming eyes and gasp for breath.

"And so to bed . . ."

●A fire inside, big enough to keep us warm in the night, would have shriveled the palm-leaf roof with its heat and let in all the rain. So, revived by hot tea and a meal of bread and canned beef, we set about building an extension to the shelter—a "skillion" in Australian parlance. The fire soon drove off the leeches, and we sat dozing before it well into the night. When the downpour slackened a bit, we spread wet blankets on wet palm leaves and turned in. Lightweight plastic-coated nylon raincoats were a boon to George and me. We could not travel in them, but worn over our wet clothing they kept the wind out. Worn over dry clothing while we slept, they retained our body heat and saved us from being soaked by water that dripped from the roof.

At dawn, the rain looked as though it would never stop. But we had food enough for only another day, and weather had to be disregarded if we were to achieve our objective of examining the upper levels of the mountain. We wanted to compare the ecology with that of the mountains of New Guinea and of lower mountains on the Cape York Peninsula, and to collect plants which so far as is known occur only on the top of Bellenden-Ker. One of my side interests was the collecting of seeds of Meston's mangosteen, endemic on this mountain and reported to have a fruit quite good to eat. I had been asked to obtain seeds for experimental planting and crossbreeding in Florida.

Trivial though it now seems, changing back into clothing that was not only half wet but befouled by smoke from hanging in the shelter seemed even more of an ordeal than the subsequent certainty of a cold drenching and more leech bites, and we lingered at the fire to warm the sorry garments before doing our changing.

Elfin Woods

On the 2000-foot climb that morning, the rain forest of tallish, straight trees, in which I searched unsuccessfully for the mangosteen, reached close to the summit. There it gave place to montane cloud forest, very different in character and largely so in floristic make-up. This was the well-named elfin wood of tropical mountains — gnarled, crowded, stiff, often misshapen small trees, at most sixteen to eighteen feet high, heavily mossed on stems and branches and deep in moss on the ground. Soft moss cushions, absorbent as bath sponges, dripped amber drops of water they could not hold. The rain was almost sleety up there. Shifting, swirling mist limited vision to a few yards, giving an eerie effect in such surroundings and producing the curious, padded silence peculiar to mountaintops when the mists are down.

Wooroonooran, the aboriginal name for Bellenden-Ker, has an apt natural suggestiveness for the summit as we saw it. It is perpetuated in the name *Leptospermum wooroonooran*, by which botanists know a striking, umbrella-topped tree that grows bigger than any other in the elfin wood. Another remarkable tree found nowhere else is the tree heath *Dracophyllum Sayeri*, with bell-shaped pink flowers and long narrow leaves that sheath the branches. We searched in vain for the beautiful red flowers of Australia's only rhododendron, *Rhododendron Lochae*, which grows on this and a few other northern mountaintops. The only really colorful things were big salmon-pink slugs, conspicuous on the leaves of trees and apparently well adapted to conditions that were anything but congenial to us.

Six hours after leaving it, we

▲ Pack horses were used in the rough mountain country. This resting place is surrounded by casuarina trees, "oaks" to Australians because of the grain of their wood

➤ From Bonanza Creek Camp, on the headwaters of Archer River, gear and supplies were carried on pack horses to camps on the McIllwraith Range

◄ Willie, Mr. Brass's native assistant, on the rocky heights of Tozer Range were back at Tick Camp, preparing for our second and last night in its drippy shelter. This time we made sure of more comfort, though the rain kept on and there were itchy new leech bites and inflamed old ones, about which we could do nothing. More leaves were put on the roof and more on the ground, and there were bundles of plants for pillows. Only three inescapable drips disturbed me—one on my feet, one on my body, and one that spattered beside my head. Such was our experience in a mountain haven that others had named for a pest we did not see.

Happier Days

One of our most pleasant camps was in the Mossman River Gorge, 60 miles north of Bellenden-Ker, where we lived under good conditions in rich rain forest that was a naturalist's Eden. As guests of the caretaker of a small hydro plant, on a do-for-yourself basis, we had the use of electrical cooking appliances and a telephone, as well. There were delectable pineapples, bananas, and papayas from Jim Cobb's garden; and there were hottish days, during which Geoffrey Tate wielded his butterfly net in the clearing or went with me into the forest to collect more humble insects in moss and under stones and rubbish, while I gathered plants. Clear, cool water rushed between great granite boulders in the river, not far from a slowly swirling, almost emerald-green pool in which we swam at midday. On still evenings, Hobart Van Deusen, after setting his traps, would take gun and head lamp to hunt tree-dwelling mammals of nocturnal habits and shy rain forest wallabies, which go by the name of paddymelon. There were only we three of the nine men who made up our full party on the more northern parts of the Peninsula.

Our farthest camp of all was on Newcastle Bay, less than nine miles from Australia's northernmost point, the tip of Cape York Peninsula, and only a hundred miles across the island-studded Torres Strait from territory that George and I had worked in New Guinea on a previous Archbold expedition. It was rigged in the shelter of low, wind-clipped trees on sand dunes immediately behind a broad, open beach, with the kitchen fly and George and Van's mammal department on one dune, Geoff and I on the next, and the tent of our three blackboys on a third. Little streams, heading in a boggy hollow where pitcher plants grew and running among pandanus trees where they passed between the dunes, provided water somewhat peaty but good to drink.

Day and night, a strong southeaster blew without letup, sifting sand into our tents and our food or driving showers in from the sea and back over the land. These frog showers, or gammon showers, as they were called, would perhaps be the only rain for months, for this was May and the wet season had ended several weeks before. We were in territory in which (except on and about the higher mountains, of which Bellenden-Ker is an example) the year is divided into well-marked wet and dry seasons. Good rains would probably come from thunderstorms in November, but the big rains of the nor'west monsoon would not arrive until about the New Year.

The Pattern of Life

This climatic rhythm, with rainfall enough to support rain forest in the most favored situations, and a long dry season well suited to drought-resistant grasses and trees in the drier localities, prevails both in northeast Australia and parts of neighboring south and southeast New Guinea. There is geological evidence of direct land connections between the two areas in times since the evolution of modern plants and animals. It is therefore not surprising to find, in large areas of New Guinea having pronounced wet and dry seasons, a *Eucalyptus* and tea tree (*Melalenca*) type of open forest vegetation typically Australian in character, inhabited by characteristic Australian birds and Australian mammals such as wallabies. Nor is it surprising that trees and other plants with origins in the Malaysian center of plant distribution, of which New Guinea is a part, should comprise much of the rain forest flora of northeast Australia, and that in these rain forests should be found riflebirds and the cuscus, representing New Guinea faunal groups.

These are examples of only some of the gross aspects of the complex pattern of plant and animal distribution in Australia, New Guinea, and the great Malay Archipelago lying between Australia and Asia. These and other origins, distributions, and relationships are established as far as materials for study and present understanding go. Three Archbold expeditions to New Guinea contributed much to knowledge of the fauna and flora of that rich island area. It was the need for more materials for study—both collections and observations on environments—that took us to the Cape York Peninsula, on the biological highway between Australia and New Guinea. In its northern parts especially, little is known of the plants and of most groups of animals.

Rough Travel

●Newcastle Bay Camp was reached by crossing the tip of the Peninsula by an old disused road that passed through rain forest as well as open forest of bloodwood (*Eucalyptus terminalis*) and tea tree. The wet season had left the grass high, obliterating the road in the open forest; and a cyclone had cluttered much of the area with fallen trees. In the open forest, most of the down timber could be dodged by detouring through the long grass. In the dense rain forests there was nothing to do but to clear the road or cut a new one with axes and machetes. With a driver more timid than Dick Holland, who did our transport there, or a truck less sturdy than his war surplus four-by-four, the last eight miles would have taken more than the five hours in which we did it. Dick drove over everything the truck could climb, knock down, or crush with its weight. And that rough trip yielded a very good collection of spiders and insects, shaken down on the mixed load of baggage and men.

An unusual way of acquiring specimens? Perhaps. But nothing to approach Van's shooting of the marsupial flying mouse, *Acrobates*, on a night hunt from Newcastle Bay Camp. Van shot into a flowering bloodwood tree. The animal fell and he lost it in the grass. Next morning, mindful of flesh-eating ants, Van visited the spot bright and early. A long search disclosed nothing but a python, coiled under a log and bulging with something it had swallowed. Van had found his *Acrobates*, but the tiny creature was not the cause of the bulge. With it inside the snake was a bandicoot, a somewhat piglike, small, ground-inhabiting member of the great diversified group of Australian marsupial mammals of which the largest and perhaps most widely known, are the kangaroos.

As the dry season advanced, we moved south in stages, examining the rain forests of the wetter areas, the tracts of dry, scrubby vegetation known as turkeybush, and the open forests or savannas that cover most of the country and are burned over almost every year after the grass dries. With us then was Donald Vernon, of the Queensland Museum, collecting birds and mammals for his institution. He was always an energetic helper in such community jobs as setting up and dismantling camps. Our culinary department, very important on a long expedition, was in the care of Joe McLaughlin, an old-timer on the Peninsula and a friend of everyone.

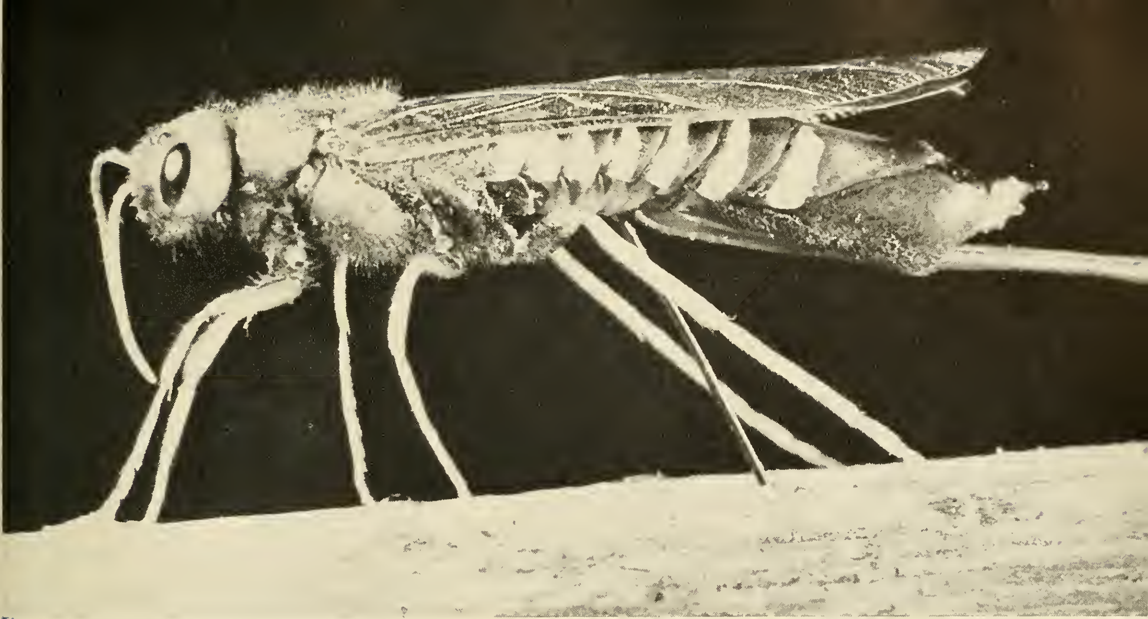
Scattered Settlers

●It was a vast country, very thinly inhabited. In a few areas, miners of gold and tin and cattle ranchers lived, sometimes with their families, in the isolation of the outback. Few of the aboriginal natives roamed their old hunting grounds. Most of them were gathered at missions on the coast or were working for white men. Our shifting community was one of the main centers of white population on the upper Peninsula. Coen township, the largest center in 350 miles, had only 25 voters.

At Iron Range we lived in a building that Americans knew as the radio station of a big military airfield in World War II. Mostly, our camps were what we made of them, with tents and flies, a minimum of portable furnishings, and ingenious improvisations on the part of Joe. Sometimes we slept under the open sky, not troubling to rig unnecessary shelter but putting up mosquito nets to keep off the dew. There were few mosquitoes to bother us in the dry season and not much risk of malaria. Leeches would not be much in evidence again until the wet season and then only in rain forest localities.

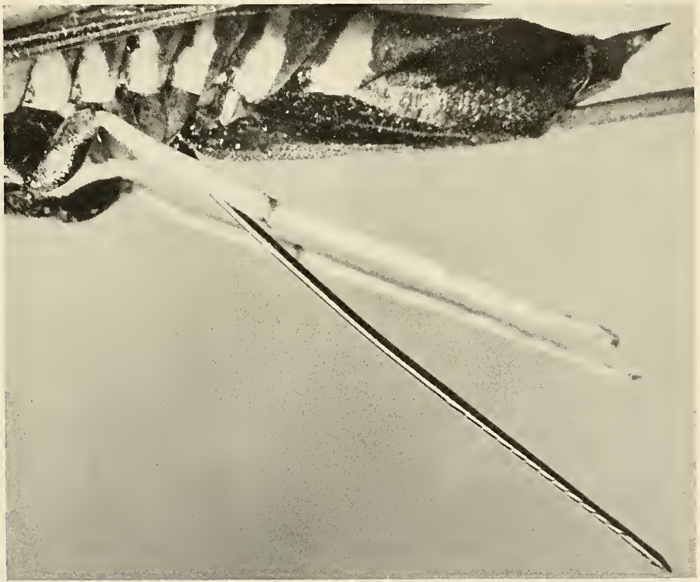
Some of our camps were beside the rough, two-wheel-track roads we traveled by truck. Others, up in the mountains, were reached by pack horse train or by cutting trail and carrying all the bare essentials ourselves. Homes were hospitably thrown open to us wherever there was settlement, and the splendid pioneer womenfolk were liberal with dainty eatables, which Joe, with his simpler grocery stock, could not achieve. There were also feasts of our own contriving, as when fresh vegetables and fruit reached us from the monthly boat that plied the coast or when Joe cut chops and roasts from a fat wild porker brought in by one of the blackboys. The boys, cooking their share in their own way, sang a contented corroboree down by the creek. Fresh meat always was an event. It meant a change from the dry-salted beef that hung for keeping on the poles of the tents and, with good yeast bread baked in a camp oven, was the foundation of most of our meals.

For us each day brought events —things new to the collection, something fresh to discuss, successes, disappointments—for not every day was, or could be expected to be, a good day for all of us. But as time goes by, most of the days will lose identity as days. There will be a sorting and arranging and synthesis of our recollections of the Peninsula. And the rearrangement will be largely a grouping by the camps that were our living places and the centers of our activities.



▲ **Horntail** drilling in tree trunk to lay eggs

▼ **Close-up** showing the ovipositor of the horntail



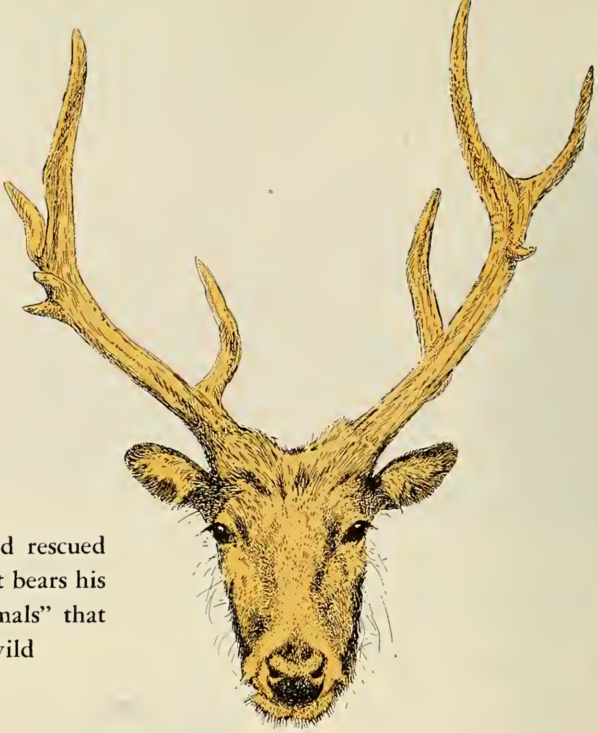
Drillers OF THE INSECT WORLD

By Lynwood Chace

INSECTS are frequently equipped with finely fashioned tools that can do just as complete a job as any of the best made by man. Here the horntail is shown at work, drilling a hole in the trunk of a tree by means of a drill and ovipositor that extends from the insect's abdomen. Into this hole, approximately half an inch deep, the horntail will deposit her eggs. The highly magnified view below shows the nicety with which nature has designed this implement.

Mechanically amazing as this implement is, the situation is perhaps more astonishing from the philosophical point of view. One might suppose that such a difficult and ingenious method of laying eggs would guarantee security for the future generation of young horntails. But not so. If an insect belonging to one of several species of *Thalessa* happens along, it will locate the larvae of the horntail beneath the bark by methods no one has ever explained. Then, with a drill approximately three inches long, it will proceed to lay its own eggs in the horntail's larvae!

The Story of the Milu



Almost a century ago, Père David rescued from oblivion the curious deer that bears his name—one of the few "wild animals" that has never been seen in the wild

By WILLY LEY

"MY preparations for the journey were completed several days ago, and I can start out by about the end of February. Because of this intention, I hurried to have my last shipment for the Museum packed; it consists of the skins of mammals and birds and a few live plants which I have entrusted to the intelligent care of Monsieur Alphonse Pichon, attaché of the French Legation, who is going to return to Paris."

These lines were written in the city of Peking in 1866, and the writer was a French missionary who was an enthusiastic and well-informed collector of animals, plants, and geological specimens. His name was Armand David—Père David at the time he wrote these lines and Abbé David after his final return from China, where he had traveled for the first time in 1862. The contributions of the naturalist-missionary to the natural history of the Far East were numerous and varied, but his fame rests mainly on a discovery he made just before he started to write his diary. The nature of this discovery is disclosed in the lines of his diary immediately following those quoted above:

"The principal item in this shipment is the *Sse-pu-hsiang,* a kind of large reindeer of which the female is antler-less. For a long time I have tried to obtain a specimen of this interesting variety of the *cervidae,* still unknown to naturalists, which I know to exist in large numbers and for centuries in the Imperial Park *Haé-Dze,* a few Chinese *li* to the South of the capital."

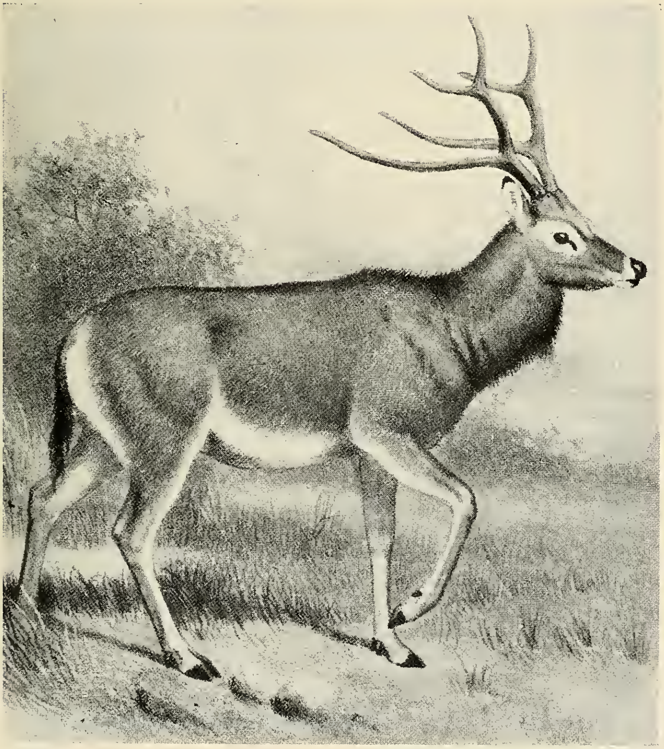
Father David's name for the park is not the one used by sinologists, but there is no doubt about the locality to which he referred. Several miles south of Peking was the Imperial Hunting Park, called *Nan Hai-tzu,* which at the time of Father David's visit was considerably larger in extent than the city itself. The area that later became a park seems to have been a kind of hunting or pleasure ground for the emperors of China for many centuries, but most of the time it was more or less open ground. It was probably walled in about 1400; in any event the wall was centuries old when Father David saw it. Needless to say, nobody was permitted to enter the park, especially a foreigner.

Having heard that animals were kept inside the park under the guard of soldiers (mostly Tartars), Father David decided that he would at least look at them, even though there was no way of wangling permission to enter. Early in 1865, he climbed the wall and saw several game animals he knew well. But he also saw a large herd—he estimated it at 120 head—of a big staglike animal that he had never seen before. He was also certain that no other naturalist had seen it, and it naturally became his ambition to record this unknown animal in the catalogues of science.

His diary contains some information that must have been supplied by native friends. He learned that there was a death sentence awaiting anybody who dared to kill one of these animals. But he also learned that the Tartar guards violated that law themselves on occasion, when their menu grew too short or too monotonous. Nevertheless, their fear of the law was strong enough to prevent them from selling anything that might be evidence; they would neither part with a skin nor with the bones or antlers. As regards the latter, there was a slight exception; Father David reported that the insides of the antlers resembled ivory so much that pieces (presumably after the outside had been ground off) were sold as ivory and transformed into various utensils by Chinese craftsmen.

Father David also learned the Chinese name of the animal, *Sse-pu-hsiang.* This means "not like four" or, more elegantly, "four dissimilarities." It is supposed to express the thought that the animal does not look like a stag, a goat, an ass, or a cow. Later the deer was often referred to under the more handy name of Mi-lu. This, however, was not known to Father David. In any event, he did what he could to obtain some evidence concerning this strange creature for the Museum in Paris. He probably repeatedly postponed the trip he wanted to make into the interior just for this reason. But for a long time his quest remained, to use his own term, "unfruitful."

At long last, in January 1866, he got two complete skins *en assez bon état* (in passable condition), possibly by devious methods, which he unfortunately did not record in detail. Shortly thereafter, the French Legation obtained three more Sse-pu-hsiang through the good offices of the Imperial Minister Hen-Tchi. These, alas, did not survive the trip, but Alphonse Milne-Edward in Paris had material for the first scientific description.



From Richard Lydekker's The Deer of All Lands

▲ Completely extinct in the wild, Père David's Deer is happily represented in several zoos. During wartime restrictions, half the Woburn Abbey herd starved, but it has provided the London Zoological Society with seven and the Bronx Zoo with four. Four others will go to Australia soon

As is customary, the first describer had the privilege of proposing a scientific name, and Milne-Edward chose *Elaphurus davidianus.* In English-speaking countries, "Père David's Deer" has become the usual appellation. This is nice in that it honors the discoverer, who might have had to pay dearly for his scientific curiosity. But it is not quite so short and simple as Milu, which is the common name on the continent.

Even at first glance, Père David's Deer appears to be a peculiar creature. In size, it is rather large; a full-grown stag will stand four feet at the withers, about the same as a red deer. But its general carriage is quite different, a fact that has not always been known to taxidermists who mounted specimens. Instead of carrying its head high like a deer, the milu usually carries it low, more like a cow. The whole attitude has been termed "slouching" by Lydekker. The tail is unusually long for a deer and is equipped with a hairy tassel like that of a donkey. The animal has both neck and throat manes. It has rather large, wide-spreading hoofs, which fall together with a loud, clicking noise when it walks slowly. The antlers are especially strange. They are large and look at first glance as if they might have been put on wrong. The main fork curves forward, dividing at least once. The hind prong, which is undivided, is very long and is directed backward in a way that is unlike any other antler known.

Usually only one young is born, in May. The fawns are heavily spotted with white, but as the animal grows up, the spots vanish. The females seem to retain them a little better than the males. The adults have a grayish-red coat in summer, which shades to whitish tints on the underside. In winter the coat is a grayish-buff. The call of the adults is more a bray than the typical call of deer.

After Milne-Edward's description had appeared in the *Comptes*

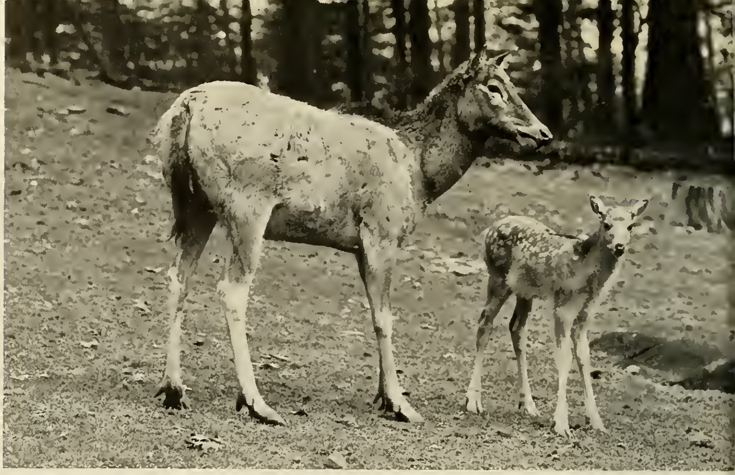
Rendus des Séances de l'Académie des Sciences (1866, page 1090), where the name Milu is used for the first time, the directors of all zoological gardens had a brand new dream—to acquire and exhibit a pair of milus. The various legations in Peking suddenly received instructions concerning zoological matters, and they were usually successful on a small scale. After all, the Imperial Hunting Park was not actually used for imperial hunts, and Père David himself had pointed out that he had been told that no hunt had ever taken place there.

In 1869, two live specimens were presented to the Royal Zoological Society of London by Sir Rutherford Alcock, and in 1883, the same Society bought two more in China. One specimen arrived in the Berlin Zoological Garden, where it lived unhappily and lonely for many years and indoctrinated many Berliners with the belief that "stags in China look like that."

The Duke of Bedford, father of the present Duke, decided to add the milu to the collection of rare animals in his park at Woburn Abbey. He bought all the milus that could be bought anywhere. It was at Woburn Abbey that a surprising discovery was made: the milu sometimes sheds its antlers twice a year, instead of once!

While the heads of zoological institutions were still dictating letters to Peking, the milus of the Nan-Hai-tzu Park suffered a catastrophe. In 1895, the Hun Ho river caused a disastrous flood, which sentenced thousands of peasants to death from starvation. The same flood also undermined the ancient brick wall of the park, and many of the animals enclosed there, including the rare milus, escaped and were killed and eaten by the starving populace.

Still, it cannot have been the end of the whole herd. Some must have survived, because it is reported that "the Imperial Hunting Park was thrown open in 1900 and all the deer in it killed by the International troops." In 1901 only one milu, a female, still existed in Peking. It stayed alive until 1920.



New York Zoological Society photo

▲ One of the Bronx Zoo's Milus, with the first fawn ever born in the Western Hemisphere. Its white spots will disappear with growth

This was the last Chinese milu, for the major mystery surrounding this animal is that it has never been found in the wild anywhere. When Père David saw the large herd from his place on the brick wall, and when his discovery was reported in Europe about a year later, most naturalists began to wonder about its normal distribution. None were known from the reasonably well-known areas of China near the coast, so its habitat must probably be found in the interior. The possibility that it was otherwise extinct and had survived only in the park did not occur to anybody. The natural assumption that there had to be wild milus somewhere was apparently strengthened by reports of travelers who told that native guides, especially from the northern parts of China, had told them about occasional small herds of Sse-pu-hsiang. But all these reports were mistaken. The guides really meant reindeer; and this was dramatically demonstrated in 1904 when a hunt undertaken by Chinese netted eleven Sse-pu-hsiang that were to be shipped to Woburn Abbey. Ten of the eleven died during the journey to the coast; the eleventh proved to be a reindeer. Some entries in Père David's later diaries must be founded on the same mistake. It is important to note that Père David never saw any of the animals he was told about.

Possibly native Chinese, living a considerable distance from Peking and knowing nothing about the real milu, took the term "four not alike" and fitted it to an animal they knew, the reindeer.

Regarding the original habitat of the milu, there are two theories. One is that it was brought to China by the Manchu. This idea, however, while somewhat romantic in tinge, has nothing else to recommend it. In fact, it may refer, through these mistaken reports, to the reindeer. The other is that the milu's original home was on the large plains of Chihli Province, which in former centuries were immense reed-covered swamps. As agriculture advanced, drainage of the swamps and cutting of the reeds gradually left the milus homeless, so that they dwindled in number and finally survived only in the area that became the Imperial Hunting Park.

A precise parallel to this can be found in the fate of the European bison or wisent, which also roamed over most of Europe when the continent was still covered with dense forest. It receded with the forests until it finally survived only in an Imperial Hunting Park—the famous forest of Bialowiecza, not far from the spot where before the First World War the three empires of Germany, Austria, and Russia met.

New York Zoological Society photo

▲ **In the velvet.** Père David's Deer withstands cold well. Even the growing antlers do not seem to suffer frostbite

In fact, the parallel goes so far that the largest number of pure-blooded wisents still alive are now at Woburn Abbey, too.

The idea that the milu preferred such areas as the former swamps of Chihli Province is also bolstered by observations of the Woburn Abbey specimens: "In England during summer they are very partial to water, often wading out as far as they can go and sometimes swimming; at this season they feed largely upon water-plants, especially rushes. The long and widely expanding hoofs, which form one of the characteristic features of this species, are evidently adapted for walking on marshy ground." (Lydekker, 1901.)

After the destruction of all the Chinese milus except the one female, most living milus existed at Woburn Abbey, about twenty of them at that date. It can be said right now that the story has a happy ending; there are today more than 240 milus in England.

An inquiry about the growth of this herd and especially about winter care of the animals was kindly answered by the present Duke of Bedford. In a letter dated April 15, 1949, His Grace informed me that the number of milus at Woburn Abbey as of that date was 242—45 stags, 119 hinds, and 78 last year's calves of as yet undetermined sex.

"Eighteen Père David's Deer were originally imported from various Continental zoological gardens," continued the Duke of Bedford, "but of these at least three never bred, so that the present herd is descended from not more than fifteen animals. By the end of 1913, 137 had been born, 47 had died and 35 had been killed owing to old age or disease, and one had been sent away. During my father's life-time, I think, only two stags were sent away, one to Karl Hagenbeck in Germany and one to the London Zoological Gardens. During the summer of 1914, 20 calves were born, and there were 88 animals in the herd. During the First World War, however, quite half the herd perished of starvation, as the authorities insisted on sheep and cattle being turned into the Park and did not allow enough hay to be provided for winter feeding. I had to put up a great fight to prevent official folly from having similar disastrous consequences in the last war."

In resistance against winter weather, the survivor from Old China has proved rather hardy.

"The deer here run in the open Park, where they have access to open-fronted sheds, which are used a good deal by the adult animals, but rarely by the young ones. The sheds are unnecessary from the standpoint of giving protection from the cold, as the deer are able to stand very severe weather, and even the growing antlers of the stag do not seem to suffer from frostbite. . . . The only artificial food that is necessary in winter is hay, but of this there must be an ample supply. If there is any shortage and the young animals are allowed to get into a low condition, a number are lost from parasitic worms. Unlike most deer, Père David's do not care for the branches or fruit of trees, nor do they eat turnips. Apart from grass, the only natural food for which they show any fondness is certain water plants."

Since the herd is now so large, it has been possible to restock zoological gardens from Woburn Abbey. A total of seven animals have been given to the London Zoological Society, but through the natural course of events there are now eight. Likewise, New York received four and now has five, a fawn having been born on April 10, 1949, the first birth in the Western Hemisphere. During this year, four milus will be shipped to Taronga Park near Sydney, Australia, and four to Dr. Heck in Munich, in exchange for Mongolian wild horses (*Equus przhevalski*).

In the course of time, more and more people in various corners of the world will be able to see a milu again, discovered not quite a century ago near Peking. Extinct in nature and almost extinct even in captivity, it was saved at a time when to any sane observer the case must have seemed hopeless.

The SAND-HILL CRANE *Still Calls*

Reminiscent of the broad unspoiled wilderness, its distinctive cry and the pattern of its wings against the sky will always thrill the fortunate observer

By HENRY H. SHELDON

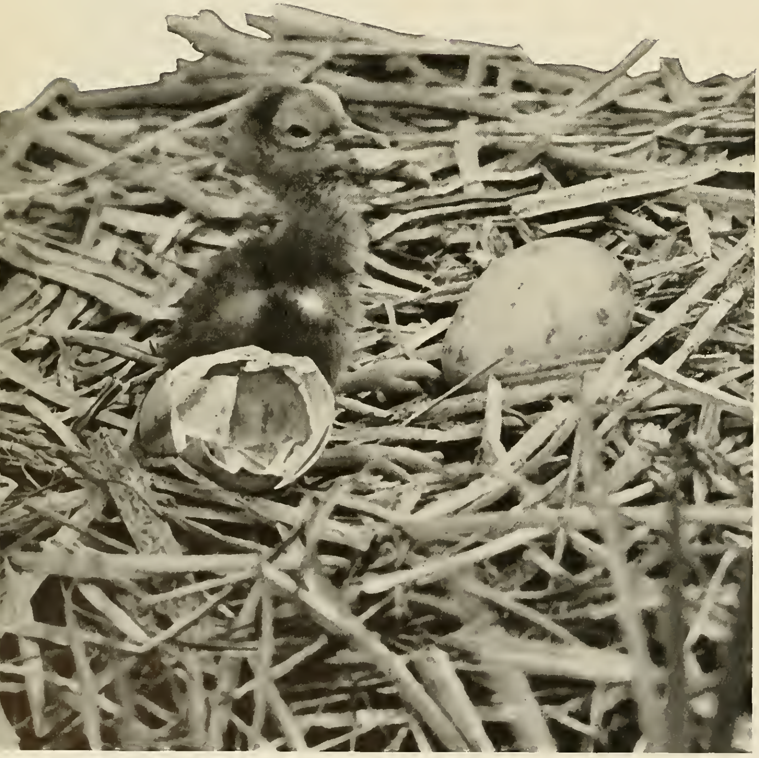
Photographs by the author

ONCE heard, the far-reaching call of the sand-hill crane is a sound that never can be forgotten. The notes roll out like a ratchet on a giant pulley, though not without a certain vibrant, musical quality. And when a group of these great birds fly over with their clattering notes of song, the impression is startling. A flock of cranes on migration, flying follow-the-leader fashion high in the sky, leaves no uncertainty as to their identity, for they never fail to sound their characteristic notes, which can be heard from one to three miles away.

One of my early impressions of the sand-hill crane came while on a survey of the big Bad Lands of South Dakota. No great wilderness is more profoundly desolate and silent than these badlands; so when a flock of sand-hill cranes gave voice, I thought I had never heard any bird notes so beautiful and satisfying. The sight of them a mile high was equally inspiring, and as the late naturalist Vernon Bailey so aptly described them, "I watched their southward flight until all was gone but the sound of their magnificent voices."

During the first settlement of the white man in Oregon, sand-hill cranes were abundant; in fact, even as late as the first years of the present century, a flock of a hundred or more was not an uncommon sight. But today the sand-hill crane is considered a rare bird over its entire range, which extends, in the breeding season, from Canada to California and as far east as South Dakota and even Michigan. The mountain meadows and marshes of the western states are its natural nesting haunts. In the fall it leaves them to migrate south to Mexico and Florida.

Those who stick to the paved highways will not see these big



↖ JUST HATCHED. A day later, the other chick emerged. Sand-hill cranes build their nests in the water, as a rule in a swampy meadow near a jungle of cattails where the young can seek safety

▲ A PAIR of anxious parents that came close but changed their minds about landing

birds, and assuredly they present a sight worth viewing. Usually a high-powered binocular will be necessary if you want to watch them feeding. They eat frogs, snakes, grasshoppers, field mice, and, in fact, almost any creature that can be subdued by their powerful beaks. A meadow mouse that dares to course its runway is snapped up in a flash, sometimes flipped into the air, caught, and swallowed with the aplomb of a juggler. Cranes are also fond of a variety of vegetable matter, including grains, but they do not often do any great damage to grain fields, because it is their habit to avoid association with man.

During the breeding season, which begins in April, the cranes stage a courting dance which, from the accounts of those who have been fortunate enough to observe it, must be a most spectacular and amazing sight. S. S. Visher's description has been called the best account of this performance. Briefly, the great birds, perhaps 20 or more, gather at a chosen site on some high piece of ground where they can command a view in any direction for half a mile. They begin by raising their heads to their extreme height, then bowing low. After repeating this several times, they begin bouncing like feathered balls, leaping over one another with wings half spread. The speed increases as new flocks fly in to join, and after an hour or more the dance becomes a wild frenzy.

Many species of birds perform these nuptial antics of courtship, but my imagination tells me that these cranes, standing four feet high from toe to beak, could put on a show to outdance anything else in the bird kingdom.

Most people unacquainted with the general features and characteristics of the crane confuse it with the great blue heron, which is often wrongly referred to as a crane. As the two birds belong to widely separate orders, they are obviously quite different. However, one not up on birdlore might easily be uncertain whether he saw a heron or a crane, especially if the bird were standing at a distance. Both birds are blue-gray in color, and though the crane is the larger, distance and light alter the apparent size of all creatures. In such an instance, be-

➤ THIS LITTLE FELLOW was lost temporarily. Its plaintive call was a weak whistle, but the parents heard it and came

▲ A PAIR OF CRANES near the nest, apparently unaware that the cameraman was hiding nearby in the sagebrush

havior would be the sole means of identity. Once on the wing, there is no mistaking either bird. The crane flies with neck and legs stretched full length, while the heron pulls its long neck into the feathers of its breast and resembles the crane only in its outstretched legs.

Despite the crane's isolated habitat and its wary nature and habit of feeding in open areas where its keen eyesight prevents any foe from too close approach, it is dangerously decreasing in numbers. The chief cause is the encroachment of civilization upon its comparatively restricted haunts.

Up on the Malheur National Bird Refuge, which runs parallel to the Steens Mountain Range for some 30 miles, 90,000 acres have been fenced. This great area comprises a variety of terrain suitable for the propagation of such precious species as the sand-hill crane, trumpeter swan, American egret, glossy ibis, and others. This is just one of several of Uncle Sam's bird havens that have been set aside for the protection and preservation of our wild fowl.

Here the sand-hill crane is in its chosen element—an expansive meadowland, watered by streams that issue from the alpine Steens Mountains and flow eventually into the great Malheur Lake and marshland. This avian paradise had always been home for the cranes, and thanks to wise and farsighted conservationists, it remains their refuge indefinitely.

A Tree with a Maltese Cross

By Marie Copeland

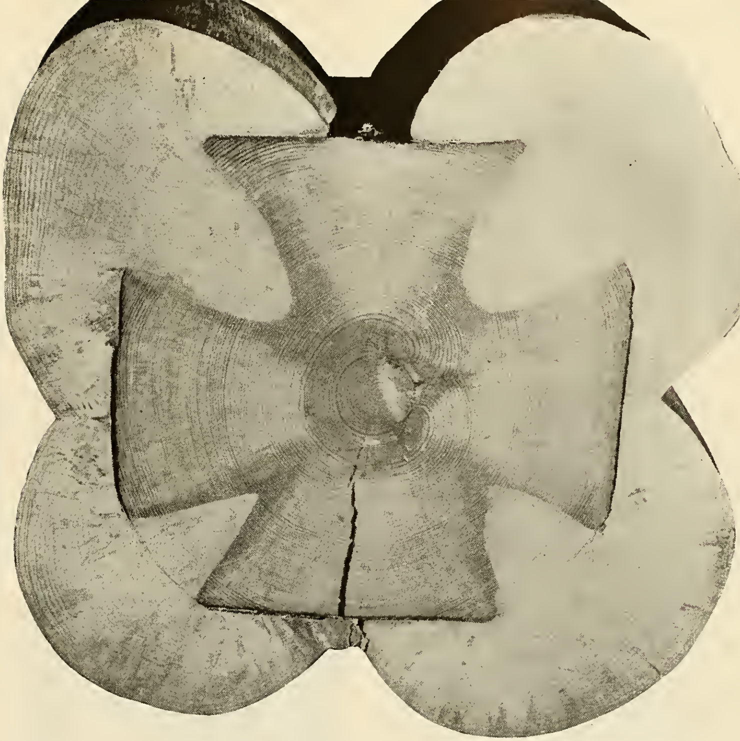


Photo by Willard Hatch

NATURE does some queer things, but almost everyone who sees this section of a tree agrees that it is one of the strangest oddities he has ever seen. As the photograph shows, the tree contains a well-nigh perfect design of a Maltese cross.

Two hunters were tramping the timbered foothills of the Rocky Mountains in western Montana when they paused to rest at the foot of this yellow pine. Its peculiar shape — like a four-leaf clover — caught their eye. Returning later with a crosscut saw, they felled the tree and found that the curious cross extended the entire length of the tree trunk. Much of the tree, however, was rotten and was discarded by the finders. The trunk was about fourteen inches in diameter.

So perfect is the outline of the cross that at first glance one asks: "Is it inlay work made by man?" But Nature's "inlay" is more real and convincing than any handiwork man could create. Each tiny line, indicating a year's growth of the tree, is easily traced completely around the face of the block. In the center or heart the grain forms a convincing replica of the all-seeing eye, similar to that used in the emblem of Masonic Lodges.

The cross is now a part of the writer's collection at Yakima, Washington, among numerous other northwestern curiosities gathered over more than a quarter of a century.

What force could have disturbed this tree to produce such an unusual formation? Was it struck by lightning? Did the winds blow? Or was it stricken with some dread tree sickness? Many persons have pondered over this question, but perhaps the best answer is offered by Dr. William M. Harlow, of the New York State College of Forestry. He writes as follows:

"This is without doubt one of the most interesting tree sections I have ever seen. Although at first the pattern may seem unexplainable, a careful study of the ring growth makes clear what happened to the tree. The "eye" effect near the center is not unusual and has resulted from some injury, perhaps a fire scar, when the tree was quite small. Notice how the rings cover the scar and eventually join again to form complete circumferences.

"Now, look at the top of the cross and notice that a similar condition has developed along the flat surface shown. On the other three faces the new wood has completely covered the scars. What caused the scars? It seems likely that this tree was blazed on four sides to mark it, perhaps for land survey purposes. The Maltese cross consists of heartwood; the rest of the cross section is sapwood. Although even the sapwood of this pine, as well as that of other trees, consists largely of dead, empty cells (in this case tracheids or 'fibers'), it does contain a certain amount of living tissue, namely the wood rays, and living cells around the resin canals. When these living cells die, heartwood formation is said to take place; and at this time various chemical substances may be deposited, which usually make the heartwood darker than the sapwood. When the tree was blazed, heartwood formation was initiated earlier than normally would have occurred, because all the living cells from the cut faces were deprived of radial communication with the cambium and bark. This accounts for the curved 'bay' between each two faces.

"If this explanation does not satisfy the reader, he can easily test it by actually making a 'four-square' set of faces on a living tree and observing the results over a period of years."

LETTERS

Continued from page 338

Bering Sea and the North Pacific, where they prowl in relentless search of prey. They are the most ferocious of marine animals, able to swallow seals and the smaller porpoises at a gulp, and even to kill the true whales. The Eskimos in their skin boats have great respect for the Killer Whale and avoid any encounter with it.

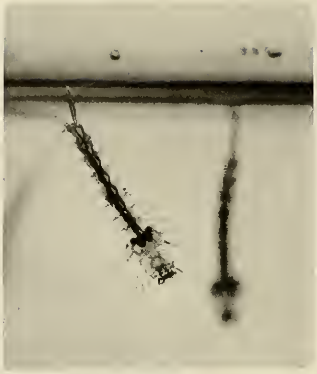
Insects that Outwit Carnivorous Plants

Sirs:

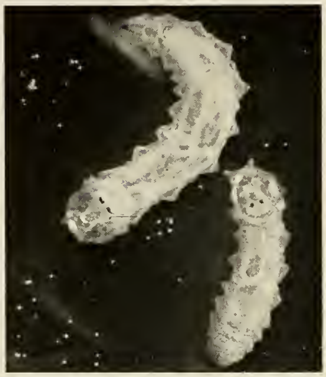
Dr. W. H. Hodge made out a most interesting case for the plant kingdom in his article on "Carnivorous Plants" in the June Natural History. The inference would certainly be that insects must be very stupid if, in spite of having brains and eyes, they let mere plants overcome them. But not all insects deserve this opprobrium. For example, the water in a pitcher plant leaf is a fine aquarium, full of microscopic food particles, and the pitcher plant mosquito takes advantage of it. This insect by-passes the downward pointing bristles by flitting into the open throat like a helicopter, descending to lay eggs on the water surface, then rising to escape again. The wrigglers that hatch from the eggs feed on the microorganisms that congregate over the drowned bodies of other insects. Each wriggler tosses itself to the surface film and presses a breathing tube through to the air above. Its gullet squeezes the pitcher plant water from each food particle before the food enters the stomach. And apparently no significant amount of the digestive juices secreted by the plant leaf enter the mosquito wriggler's skin, since it lives on, grows, pupates to a bullhead and finally emerges, to fly away to the open air beyond the pitcher's throat. But only one kind of mosquito—*Wyeomyia*—makes use of the pitcher pond in this way.

Sometimes the pitcher plant mosquito gets caught by another inhabitant of pitcher leaves—the pitcher plant spider, which spins a net across the open pitcher and catches insects going in either direction. The web is hung across the lip of the leaf, and the spider spins a silken life line on which to descend toward the water. But during rains, spider and web may both be swept into the pitcher, where the former drowns and becomes food for the plant just as does a bird's egg or a cube of meat placed in the water.

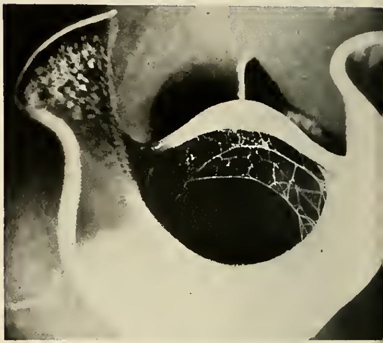
Several kinds of flesh flies—relatives of the common blow flies—also take advantage of the pitcher plant's food collection. From a safe landing strip where take-off again is easy, one of these flies will deposit its living maggots high up on the plant. The maggot slips down the hairy throat, falls into the water, but is at home immediately. The decaying insect bodies shown in Dr. Hodge's photograph are perfect food for the scavenging maggot. And for air it merely extends its body until the hinder end is at the water surface. Respiration occurs through a pair of fancy air pores surrounded by water-repellent hairs. The maggot grows as it uses up the plant's collection of drowned insects. Finally it bores a small hole through the pitcher wall, wriggles through to freedom, and pupates for transformation into the parent type of fly.



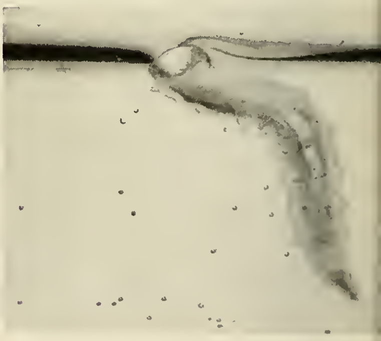
◄ Wrigglers of the Pitcher Plant Mosquito are found only in the water collected in pitcher plant leaves. In this very restricted niche they thrive on microscopic animals and plants, which in turn derive their nourishment from the decaying insects the plant leaf has caught. The wrigglers are immune to the digestive juices secreted by the leaf



▲ Pale maggots, fat and well fed at the pitcher plant's expense, operate at the bottom of the vaselike leaf, scavenging the depths of the trap for the drowned decaying bodies of insects and spiders. Given time, these would emerge through a hole in the pitcher's side and become flesh flies. The pointed end is the head. Two dark spots toward the opposite extremity are air pores, which the maggot brings to the water's surface at intervals for breathing



▲ The Pitcher Plant Spider spins a web acros the throat of the leaf and catches insects as the slide toward the depths of the trap. It snares stil others (such as the Pitcher Plant Mosquito) as the emerge like helicopters from the liquid below. Th net photographed here shows indication of havin been broken and repaired at least once—probabl when some insect fell through and was caught b the plant



▲ The maggot of a flesh fly makes its way to the surface and opens to the air above a large cup-shaped cavity, from which breathing tubes lead downward throughout its body. The aquarium water in which this specimen was photographed was saturated with air, as evidenced by the small bubbles on the glass wall. However, this curious animal has become so used to life in a poisonous environment that it absorbs nothing from it other than decaying food material

Farther south, where pitcher plant leaves have umbrella tops that keep out excess water in heavy downpours, a solitary wasp has taken the habit of cutting a hole near the pitcher bottom to drain it completely. Then it brings in straw and leaves to build a nest in which to rear its young. The pitcher plant still can use such a leaf for synthesizing foods in sunlight, but the protein-catching, water-holding feature is gone for good.

All of these are ways in which potential prey make use of the carnivorous plant for ends that do the plant no good. Perhaps careful observation will yet reveal some insect or spider that steals the sticky drops from sundew and puts them to some special use. Or some animal of small size may be found that specializes in stealing the insects from a Venus's-flytrap or through the trap door of a bladderwort. Once we found caddis cases in a pitcher plant leaf, suggesting still other and yet unknown inhabitants of insectivorous plants. No doubt those that can watch these interesting and unusual kinds of vegetation more closely can add greatly to what is already known of them.

Lorus J. *and* Margery J. Milne,
University of New Hampshire.
Durham, N. H.

Tribute to the Dance

Sirs:

The cover of your September, 1949, issue does credit to a sincere and talented young man. It is a real pleasure to see Redge Laubin receive such fine publicity. No one deserves greater credit for his complete, accurate, and warm portrayal of the life, the costume, and the dance of the first Americans. . . .

Dr. Clayton G. Rudd.
Minneapolis, Minn.

Friendly Raccoons

Sirs:

As a member of the American Museum of Natural History of many years standing, I take the liberty of sending you the following account of a recent experience with raccoons, which may be of interest to your readers.

Together with two friends and a guide, I spent two nights this July at Inlet Camp on the Upper Ausable Lake in the Adirondacks. About 7 P.M. a young female raccoon came to the cookhouse porch. I tossed her a flapjack, which she took immediately; then, of her own accord, she climbed onto the porch. All four of us were sitting only a few feet away.

It suddenly occurred to me that I might lure her still closer. I offered a bit of chocolate, and she took it at once. The next piece I held at my knee; and at the next, she had her front paws in my lap. At the next, she had all four paws up and was sitting contentedly in my lap showing not a trace of nervousness. This all happened in broad daylight while the four of us were talking in ordinary voices, and others were moving about getting more flapjacks and syrup for her. If we had had a camera, we could have taken innumerable pictures, as she stayed in my lap about twenty minutes and only left after all the food was gone. She had even licked my fingers for the final drop of syrup.

We were the first occupants of this camp this year, and the other near-by camps had barely been used. As she was a yearling, her experience with humans could therefore only have been as a kitten the previous summer.

The following night we were waiting for her, but instead a large male raccoon came, and the same performance was repeated almost exactly, except that he was so big that he could only get his front paws in my lap. Even so, his face was within eight inches of mine. His mannerisms and personality were totally different; he was aggressive, impatient, and determined, also completely without nervousness or fear, whereas the female was gentle and unhurried. Neither animal had ever seen us before or had become familiar with our voices, scent, or motions.

Our guide and others with whom I talked all said that they had never seen or heard of anything like this. I know that raccoons are easily tamed, but I would greatly appreciate it if you would tell me if you have had other similar incidents reported.

Mrs. Edward Clarence Dean.
Byram, Conn.

The following comments are offered by Mr. T. Donald Carter of the American Museum's Department of Mammals:

Mrs. Dean's account is very interesting. On rare occasions, for no apparent reason, an individual mammal or bird will lack the accustomed fear and seek the society of humans. But it would seem very strange if two such animals should make their appearance at one time, and I would rather suspect that these raccoons had been associated with people at some previous time. The most logical explanation would be that they were either in captivity and had been liberated or had escaped, or that during the previous summer this family had been attracted to one of the camps, perhaps to visit the garbage pail. If animals are offered tempting food, they can be induced to take it from the hand. It does not take some animals long to learn how and where such handouts may be obtained. The fact that the first raccoon showed no nervousness is good evidence that the procedure was not a new experience to her.

LITTLE KING OF THE UNDERWORLD

Continued from page 365

earth against the nests of yellowjackets until the insects were completely crushed or smothered. The attacking mole then safely devoured both the young and adults.

The mole's adaptations have confined him to a life in lightless labyrinths. The round of his experiences consists mainly of smells of fresh moist earth, plant roots, and various worms and grubs he seeks out for food. Digging hangs so heavily on his mind that he may sometimes be seen going through the motions of digging even in his sleep.

These earth-cleaving and feeding habits do not go completely unobserved, especially if they appear in the garden or on the golf course. Prized daffodils are felled, and key golf shots are shaken from their course.

Fortunately, there are two sides to the matter. Moles are injurious only when they appear in concentrated gardens or in golf courses. Elsewhere they do a world of good by eating large numbers of destructive insects. In fact, just one mole can consume about 40,000 insects and worms each year.

Through the ages they have also played an important part in the evolution of the soil. By constantly moving and stirring it, bringing up subsoil, and carrying down organic matter from the surface, they have contributed to the natural building up of soil fertility.

With man's occupancy of the land the value of moles as cultivators ceases. Their natural process is much too slow. But in the uncultivated areas of the earth, the little king of the underworld still remains a useful citizen—the symbol of one of Nature's most complete and successful ventures into the realm of subterranean darkness.

Winners of the Insect Cryptomaze in the June issue of Natural History: The three contestants submitting the highest number of insects listed in the main section (A-Z) of *Webster's New International Dictionary*—1948 (unabridged), in accordance with the rules of the contest, are: Harold Eaton, Jackson Heights, N. Y.; Dr. Henry S. Rich, Bronx, N. Y.; Dr. Ellsworth Smith, Madison, Conn. Each of these winners has received a copy of *The Insect Guide*, by Ralph B. Swain, published by Doubleday and Company, Inc.

MUSEUM ANNOUNCEMENTS

Is Indian Culture Oriental?

Possible evidences of trans-Pacific traffic from Asia to North and South America long before the time of Columbus form the theme of an unusual exhibit titled "Across the Pacific?" which will be on display at the American Museum through October.

The exhibit is the first ever to assemble a wide range of varied materials showing striking similarities in the ancient cultures of Asia and the Americas. It does not attempt to prove that continuing contact occurred in early times but rather is designed to present some of the reasons why anthropologists are becoming more and more interested in determining whether the ancient civilizations of the Far East contributed to the development of American Indian cultures.

In art, musical instruments, weapons, and architecture, many marked similarities occurring in Asia and the Americas are displayed in the exhibit. For example, the totem poles of the Northwest Coast and similar monuments from the interior of Borneo are shown to be almost identical in many cases in both form and subject. It is now believed that this art style probably spread in ancient times from China to islands of the East Indies and Melanesia, and it is possible that the American Indians received it from the same source, either across the Pacific or around its shores.

Further interesting similarities are shown in the designs on vases and stone sculptures of the middle and late Chou dynasties of China and cultures of Mexico and Guatemala, as well as in the Buddhist and Hindu art of India, Java, and Cambodia. An unusual section devoted to musical instruments of South America and Oceania points out amazing resemblances between the Panpipes of Melanesia and Bolivia, the shell trumpets of Melanesia and Mexico, and the unusual nose flutes of the Philippines and South America.

Another high light of the exhibit is a display of head-hunter trophies from Oceania and South America. The human heads and skulls on display in this section show an amazing likeness in general treatment and in the way in which they have been decorated.

This theme constitutes one of the most fascinating riddles in the science of man's early cultural development. It is hoped that readers of NATURAL HISTORY will soon have opportunity to weigh the pros and cons in an article by Dr. Gordon Ekholm, who, with Dr. Robert von Heine-Geldern, supervised the preparation of the exhibit.

"An Artist Looks at Nature"

A special exhibit of drawings, lithographs, and oil paintings by Miss Vera Andrus will be open to the public until October 18 at the American Museum of Natural History. The display includes some 40 pictures of shells, driftwood, flowers, and plants and will be based on the theme, "An Artist Looks at Nature."

Miss Andrus, a member of the staff of the Metropolitan Museum of Art and teacher for the City College of New York Adult Education Program, has prints in the permanent collections of the Library of Congress, the Metropolitan Museum of Art, and the Minneapolis Institute of Arts. Her first "one-man" show was held in New York in 1932, and she has since exhibited throughout this country as well as in Canada, South America, and Europe.

Miss Andrus is a member of the National Association of Women Artists, from which she received the medal of honor in 1941 and the members' print prize in 1949.

Native Dances

Traditional ethnic techniques will form the basis for a group of exciting new dance works to be presented this fall at the American Museum of Natural History, in the series called "Around the World with Dance and Song."

The forthcoming dance programs will include a number of new artistic dance forms created within the framework of ethnic styles. The programs will demonstrate how strict adherence to traditional techniques need not limit dance creativeness or prevent artists from enlarging and molding certain ethnological materials into interesting and varied new dance patterns.

The new series, to be held in the Museum's main auditorium, will include an afternoon program especially adapted for children at 3:30 P.M. and an evening program given for adults by the same artists at 8:30 P.M. It will consist of seven Thursday programs from October 13 through January 26.

The fabulous American dance artists Ruth St. Denis and Ted Shawn will open the series on October 13 in a remarkable "Denishawn" program. On October 27, Hindu and Tibetan dance styles will form the basis for a program of fascinating, brilliantly costumed dances by Sujata and Asoka, accompanied by authentic native music.

"The Americas in Concert Dance," a group of gaily colored dances derived from the folkways and social forms of the American people, will be presented by the Dudley-Maslow-Bales Trio on November 10. Included also in the series will be the exciting primitive dances of Claude Marchant, formerly a leading dancer in "Show Boat," and a group of vivid, skillfully conceived Spanish dances by Federico Rey and Pilar Gomez. The dances of Bali, Java, and Sumatra will be offered by Soekoro and Devi Wani and their Indonesian troupe.

For the final program of the series, the versatile and talented Hadassah will appear with her colorful new company in dances of the Orient and the Near East. Included in the program will be the powerfully moving "Shuvi Nafshi" and the lyrical, lightly humorous "Fable." There will also be a number of new works in the Israeli, Indonesian, and Hindu dance forms.

Further information can be secured by calling Mrs. Hazel Muller, at Endicott 2-8500, Extension 248. All seats are reserved, and orders for tickets will be filled in the order received.

Antarctic Skies and Telescope Making

During October, audiences in the Hayden Planetarium will travel to the antarctic regions to enjoy the stars that circle over the South Pole. Beneath constellations that we never see in our mid-northern latitudes, they will become acquainted with the problems of time and navigation that have confronted our antarctic explorers.

A special fall course in telescope mirror making will begin on October 4 and 5 at the Hayden Planetarium.

The class, a combination lecture and laboratory session, is conducted jointly with the Optical Division of the Amateur Astronomers Association and will be held in the fully equipped optical and machine shop of the Hayden Planetarium. The course includes lectures on elementary optics and on the design, construction, and use of telescopes. Each student, under the guidance of a competent instructor, may grind, polish, and figure a six-inch telescope mirror. This Pyrex mirror for a reflecting telescope becomes the property of the student upon completion of the course.

Students will attend one night each week, either Tuesday or Wednesday, for 20 three-hour periods. The course is accepted for credit by the Board of Education of New York City. Further information may be obtained by telephoning or writing the Amateur Astronomers Association at the Hayden Planetarium, ENdicott 2-8500, Extension 300.

November NATURAL HISTORY *1949*

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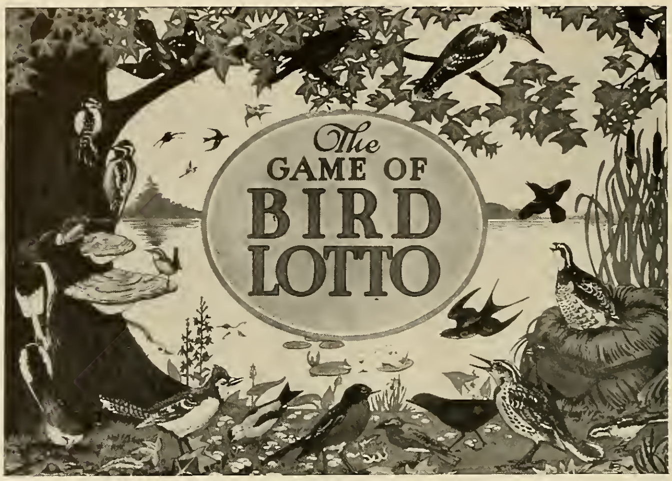

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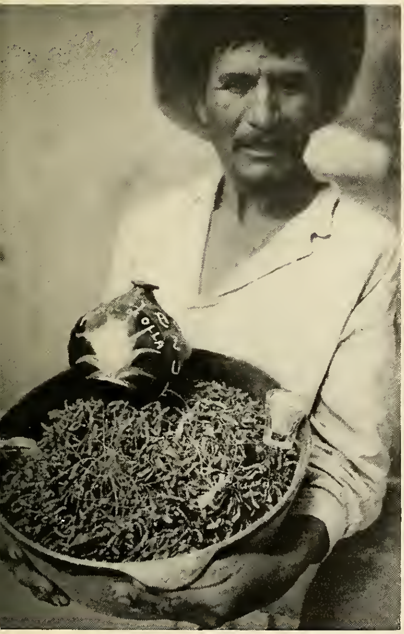
LETTERS

Insects as Food

SIRS:

You may be interested in the accompanying photographs showing but one example of man's many uses of insects as food.

This Zapotec Indian near Oaxaca, Mexico, offers as an appetizer to accompany the drinking of alcoholic mescal, fried or toasted "caterpillar pretzels." He would call them *gusanitos del maguey* (little agave caterpillars). These are actually the larvae of one of the skipper butterflies (*Aegiale hesperiaris* Walker), which are found throughout the semiarid districts of Mexico. They plague the fleshy leaves of the several species of maguey (*Agave* spp.), an ever-present source of Mexico's popular and potent alcoholic beverages: pulque, mescal, and tequila. Instead of attempting the chemical eradication of these pests, the Indians long ago hit upon a better solution: they eat them! So popular are they that they may be found in most native Mexican food markets and are even canned for the grocery store trade.



▲ STRINGED CATERPILLARS, offered by a Mexican vendor as appetizers to be dipped in salt and eaten with the mescal in the small jar

Like the writer, many a tourist has tried these *gusanitos* and has found them tasty and as appetizing as pretzels. For ease in handling, they are threaded into bunches and are individually salted when eaten (note small glass of salt). The individual pottery container at the left contains mescal.

Many aboriginal peoples throughout the world appreciate the food value of insects. Besides the Mexican Indian, I have seen Carib Indians dig out the juicy grubs of palm beetles and devour them with great relish. I have also seen highland Andean Quechua and Aymara with equal gusto hunting and eating "nutty-flavored" head lice.

Professor Essig, distinguished California entomologist, has recently summarized the nutritive value of insects in these words: "Great masses of insects are probably as nutritious and as wholesome as are oysters, crabs, lobsters, and even other types of meats ordinarily eaten by civilized human beings."

W. H. HODGE.

Amherst, Mass.

Saved by a Porpoise

IN the October, 1947, issue of NATURAL HISTORY Magazine, Mr. George G. Goodwin of the American Museum's Department of Mammals discussed briefly the ancient legend that a porpoise will push a drowning person toward shore. Like a number of other stories about the behavior of animals, this belief seems on first sight to be almost too fantastic to be considered seriously. It has apparently been passed down from classical times, and seafaring folk have doubtless always been ready to defend the porpoise as the only animal that comes to the aid of a drowning man.

The porpoise is known to be an extremely inquisitive and playful creature. It will roll under and nudge to the surface any partly submerged object that is not too large. Furthermore, when a young porpoise in the tank at Marine Studios in Florida died during the night, its bereaved parent was found the next morning supporting the young one at the surface. This was interpreted by some as an effort to help the young one breathe if life yet remained.

We now have the following very interesting account from the wife of a well-known trial attorney residing in Florida. She prefers that the location and names be omitted, because the near-accident was at least partially the result of the inattention of the owner of the bathhouse where it occurred. The "porpoise" involved was probably a dolphin, in the opinion of Dr. Frank W. Preston of Butler, Pennsylvania, a keen student of natural history who induced the lady to write her account of the experience. Along these shores the word "porpoise" is frequently applied to animals that are, strictly speaking, dolphins. Dr. Preston forwarded the account to Dr. J. Kenneth Doutt of the Carnegie Museum of Pittsburgh, who in turn sent it to NATURAL HISTORY Magazine. We print it verbatim, as follows:

"My adventure with a porpoise occurred six years ago, but the facts are still vivid in my memory and can be accepted as true and accurate.

"We had at the time a narrow beach, reached by a flight of slippery and a bit rickety steps. When I went out to my cabana, no one was in sight, nor did anyone appear when I went swimming, although my husband had asked the owner to keep his eye on me while he was away.

"The waves were not over two feet

W. H. Hodge photos

➤ THE MAGUEY PLANT, in which the caterpillars are found high, and I waded out just waist deep before I realized that there was a terrific undertow. Just as I started to turn back, the undertow swept my feet from under me and knocked me flat in the water. I swallowed a lot of water and, in spite of repeated tries, could not get my footing. I tried to call, but between the water in my lungs and my real fright, I suppose my voice was not loud enough. I realized that, while only about ten feet from shore, there was no way I could make it, and I kept thinking, as I gradually lost consciousness, please God can't someone push me ashore.

"With that, someone gave me a tremendous shove, and I landed on the beach, face down, too exhausted to turn over. I kept thinking that I must turn over and thank the person who helped me. It was several minutes before I could do so, and when I did, no one was near, but in the water about eighteen feet out a porpoise was leaping around, and a few feet beyond him another large fish was also leaping.

"When I got enough energy to get back up the steps, a man who had been standing on the other side of the fence on the public beach came running over. He asked me how I was and said that he had seen only the last part. It was the second time, he asserted, that he had seen such a thing happen. He said that when he had arrived, I looked like a dead body and that the porpoise shoved me ashore. It was his belief that the porpoise was trying to protect me from the other fish, which he described as a fishtail shark. God certainly was with me."

Here we have the first personal account that has come to our attention of a porpoise behaving as legend has said it should. It is easy to conclude, without reflection, that the air-breathing porpoise was intentionally helping a creature who would drown if deprived of air. But most students of animal behavior will probably explain the rescue as a result of the animal's natural curiosity and playfulness. They will doubt that there was any intention on the part of the porpoise to save the swimmer either from drowning or from the "shark." Porpoises do not ordinarily have any acquaintanceship with human beings, do not know whether they breathe air or water, and cannot be supposed to feel love or sympathy for them. To some, an account like this may seem adequate evidence that they do, but the scientist will say that any simpler explanation that satisfies the facts should be given stronger credence.

It is a mistake to analyze animal behavior in terms of human thoughts and emotions. Even in human evolution the idea of doing a good turn for an unknown neighbor is relatively recent. It would be naïve to assume that the porpoise said to itself, "I would want someone to do this for me" ("Do unto others, . . .") or, "It seems the only decent thing to do. This shark can probably go without one meal, whereas the person will die if left alone" ("To each according to his needs . . .").

True, there is an indication that a parent porpoise will apparently try to support its ailing young at the surface. The young of some marine mammals cannot swim at birth, and when a baby harp seal, for example, accidentally gets into the water, its mother will swim under it and help it up onto the ice again. Some may argue that the porpoise was merely going through its instinctive routine with a person instead of a baby porpoise. Is it not "a wise parent that knows its own child"? Perhaps, but maybe it is a stupid porpoise that doesn't. The mother seal, again, concerning whom more is known, unerringly picks its own offspring out from among hundreds that all look alike to us.

So, what *was* going on in the porpoise's head when it pushed the swimmer ashore? There is general agreement that the creature is sporty by nature. Under training, perhaps it will even conduct itself as "a good sport"—but scarcely in terms of human standards until it has been taught the rules of the game. Even a cynic might find it hard to remain unmoved by the appearance of a porpoise at the scene of a sinking ship, but let's not be too hard on an interesting and intelligent animal if it does not always attend to all the women and children first.—Ed.

Sparrows and Wrens

Sirs:

In my garden in the country I have a wren house, which has been inhabited this summer by a pair of house wrens. Late in June I noticed a sparrow sitting on the ledge in front of the small, round opening through which the wrens enter the house. The wrens were obviously enraged, but the sparrow continued to sit there hour after hour. When I drove the sparrow away, the wrens burst into song as if trying to express gratitude at their liberation. Since the door to the house is too small to enable the sparrow to enter, I am at a loss to understand what the sparrow was trying to accomplish. The conduct I have described was repeated day after day for several days. So long as the sparrow occupied the ledge, the wrens could not enter their house. After I drove the sparrow away, the wrens would enter and leave the house freely; but no sooner was my back turned than the sparrow would be back and the contest would continue. Can you tell me whether this type of behavior is common and, if so, what the sparrow is seeking to accomplish?

Wayne McMillen.

Chicago, Ill.

The following explanation is offered by Dr. John T. Zimmer, of the American Museum's Department of Birds:

The incident reported by Mr. McMillen is good evidence of the obnoxious character of the English sparrow, or as it is called in its homeland, the house sparrow. When it can gain entrance to the nest of a wren or some other bird that it can intimidate or find away from home, it may destroy the nest and even break the eggs or kill the nestlings. It may then take possession of the site for its own nest-building activities. When it is unable to force its way into the opening, it may, as in the present case, take a position where it can perhaps find some opportunity of exercising its destructive qualities. It is something like a cat watching a mouse hole. So long as there is evidence that the rightful owner is in residence, the sparrow may continue its behavior, even though it secures no personal gain from it, at least until it finds a more promising object of attention. Should the wrens give up the struggle and leave, the sparrow's interest would probably cease.

There is little that is admirable about this sparrow, although it has been found to eat Japanese beetles in considerable numbers. That is one mark on the credit page for many on the debit page.

Perfidious Bumblebee

Sirs:

On a bonny spring day some years ago, I retired to a woodsy, flat-floored dell in quest of the Dutchman's-breeches, flourishing profusely in the rich alluvial soil. But—what a name for flowers so exquisite and daintily perfumed!

I was annoyed to find that most of the ones I had gathered were more or less marred by tiny crescent-shaped incisions near the tips of the straddling "kniskers." It was as if the cuts had been made with a midget's manicure scissors, and they had caused rusty discoloration and shriveling. Many of the unplucked blossoms showed similar blemishes.

In a long acquaintance with the species I had never before observed the phenomenon, and I was at a loss to account for the apparent vandalism. It would most naturally be attributed to some mischievous insect—maybe an ant. But what was the *why* of it—on a wholesale scale suggesting system and purpose?

A buxom bumblebee, her sable jacket resplendent with plushy gold, was bustling busily from flower to flower—obviously a queen whom the genial mid-May sunshine had invited from her winter hibernation.

Presently my casual interest became intent: her technique was strikingly novel! Ignoring the conventional avenue ordained by Nature to insure the cross-pollination vital to the perpetuation of many plants, she embraced each blossom like a long-lost friend, then deftly but

Continued on page 431

NATURAL HISTORY

The Magazine of the American Museum of Natural History

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Wayne M. Faunce, Vice-Director
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VOLUME LVIII—No. 9
NOVEMBER, 1949

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What the sea lamprey has done to the trout catch in the Great Lakes

You will find Natural History Magazine indexed in *Readers' Guide to Periodical Literature* in your library

THE COVER THIS MONTH

This remarkable color photograph, taken by Miss Constance Stuart, the only woman from South Africa to serve as photographic correspondent in the last war, portrays two young women of the Ndebele tribe in South Africa. Many groups of this tribe have adopted the ways of neighboring peoples and have thus lost their cultural identity. But the group represented by these two girls, though only a short distance from the capital city of Pretoria, have preserved to a remarkable degree the Ndebele language and much of the traditional culture. Their dress is distinctive and artistic, with abundant use of beads, bangles, and circlets of brass. Those who unconsciously encourage the native to conform to the white man's gadget civilization might well think twice before hastening the day when such a rich artistic tradition is thrust into the forgotten limbo of vanished cultures.

Further information about this interesting tribe is contained in an article by the distinguished anthropologist Dr. I. Schapera, on page 408.

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THE INSECT WORLD

------ by J. Henri Fabre
Edited with an introduction and notes by Edwin Way Teale

Dodd, Mead & Company, $3.50
333 pp., with pictorial end papers

IT is probably safe to say that no writer on insects has won such sensational recognition as did J. Henri Fabre. It was sensational because it came, after years of relative obscurity, in a tidal wave of fame at the close of his life when he was already 84 years of age. The turning point was the completion of his monumental work—*Souvenirs Entomologiques*—and the homage paid to it by writers of distinction. At last the genius who had shunned the world of men in his devotion to a field of interest that most men pass by unnoticed received acclaim not only in France but throughout the world. The last volume of Fabre's *Souvenirs Entomologiques* was published in 1907. By 1911, a selection from this marvelous quarry of entomological information was published in English, and such was the interest aroused that volume after volume, presenting new assemblages of material from Fabre's great work, were issued over the next decade or more.

Fabre's position in entomology as in literature is one of assured eminence, but it is inevitable that with time the wild enthusiasm of the first years of an author's recognition by the world should lose its initial fervor. This is evidenced in Fabre's case by the fact that several of the chapters in Teale's thoughtfully-prepared and well-balanced anthology have been resurrected from sources "now out of print." It is to be hoped that the anthology, which brings together the most stimulating and delightful of Fabre's field explorations and experiments, will not only be valued for itself but may act as an incentive to wider reading of this author.

Teale has done an admirable task of editing. Not the least of his virtues as an editor is his self-effacement. The text is not weighed down by encumbering chains of comment, but a condensed statement preceding each chapter gives just the right amount of information required for a full appreciation of what follows.

HERBERT F. SCHWARZ.

THE CONQUEST OF SPACE

----- Text by Willy Ley
Paintings by Chesley Bonestell

$3.95
160 pp., 59 plates, 18 figs.

THE mystery of the night sky has always stimulated man's curiosity. From the time he became acquainted with the nature of the moon and planets, he naturally pondered what it would be like to visit them and how this might be achieved.

Chesley Bonestell and Willy Ley have done a splendid job of highlighting the subject of interplanetary travel in *The Conquest of Space.*

Millions have enjoyed the beautiful and scientifically accurate paintings that Mr. Bonestell has done for *Life, Coronet,* and other magazines in recent years. These have included the earth as seen from a transcontinental rocket ship, close-up views of the lunar landscape, Mars and Saturn from their near satellites, and dozens of like subjects both in color and black-and-white. Over 50 of them are reproduced here with appropriate captions. To peruse them is like taking an imaginary journey through the solar system on which we see our corner of space from a new perspective. They are not only fascinating to the layman but will withstand the critical examination of the astronomer for, as mentioned in the introduction, they are executed by "a poetical mathematician with a paint brush."

The text, by Willy Ley, has been carefully prepared to answer the hundreds of questions that perplex the nonscientist when he considers the problem of interplanetary travel. There are four chapters covering the basic problems of rocket travel, a discussion of the dimensions and dynamics of the solar system, and interesting data concerning what is known

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of the physical characteristics of the moon and planets.

Chapter IV, called "Vermin of the Skies" discusses the asteroids. We feel that the title of this chapter is not in good taste, but here Mr. Ley has followed a precedent of long standing. The book contains about a score of figures drawn by Mr. Ley to amplify the text. On the whole, it is a valuable contribution to modern popular astronomy.

ROBERT R. COLES.

INDIAN HILL BIRDS

_ _ _ _ _ _ _ by Sálim Ali

Illustrations by M. G. Henry
Oxford University Press, $8.00
240 pp., 72 plates

TIMES and fashions are changing rapidly in India today, but the popularity of the Indian hills as a refuge from the hot or trying weather below is bound to endure. For the many who, in search of relaxation, are drawn to their birds, the present splendid book is intended.

The author, Mr. Sálim Ali, leading ornithologist of India, is also a lifelong student of its birds in the field. Remembering his early days which were handicapped by the lack of a suitable book, he set out "to meet the wants of the average visitors to the hills" by writing "a handy book that would tell them by simple word and picture something of the birds they meet . . ." He has succeeded admirably. Comparison of size, appearances in the field, simple keys, and tables of distribution identify the birds. But the book is much more than a guide to identification, for under each bird a great deal of information is also given as to habits, food, calls and song, nesting, and other phases of behavior. This information is very complete and is written in a beautifully concise, non-technical language.

Close to 300 species, Himalayan as well as peninsular, chosen as being the most likely to attract the attention of the visitor to the hills, are covered in the book. Of these, 117 are brilliantly illustrated in 64 superbly printed color plates, and twelve additional species are illustrated by photographs. In some cases both male and female plumages are shown. The color plates, painted especially for this book by Mr. G. M. Henry, are beautifully done and include many species that have never been depicted before.

We are told that the book is primarily intended as a field book. But the information given by Mr. Ali on the birds that he covers is so complete and up-to-date scientifically that the professional ornithologist will often refer to it. Particularly helpful are the notes and tables on distribution, altitudinal movements, and habitats, as well as the two well-chosen end papers showing the paths of the monsoon, land elevations, and mean annual rainfall.

The bird watcher in India and the student of Indian ornithology will be grateful to Mr. Sálim Ali and Mr. G. M. Henry for their very fine book. The only regret an American reader is bound to have is that he is too far away to slip it into his pocket and set off for the beautiful hills.

CHARLES VAURIE.

HAWKS ALOFT

The Story of Hawk Mountain

_ _ _ _ _ _ By Maurice Broun

Dodd, Mead Company, $4.00
222 pp., 11 illusts.

HERE is the story of one of the world's most remarkable sanctuaries. It is also a heart-warming record of courage, devotion, and idealism.

For many decades Hawk Mountain, on the Blue Ridge of Eastern Pennsylvania, above Drehersville, was a death-trap for migrating birds of prey. Eagles, vultures, falcons, and hawks of many species, utilizing the favorable updrafts over this ridge, came within easy shotgun range of the hordes of hunters who waited for them among its rocky crags. For many of the local people, shooting at

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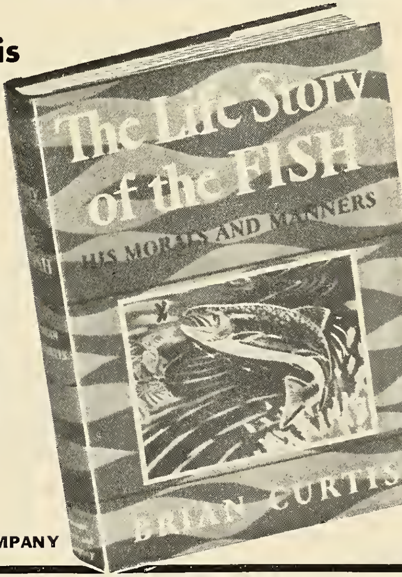

"BRIAN CURTIS has brought a tremendous amount of knowledge together and written it in as simple and engaging a manner as seems possible, all without compromising in the least the scientific principles by which the information was assembled. It is by far the best popular exposition of fishes and their living we have yet seen." — CHRISTOPHER W. COATES of the N. Y. Aquarium, in *Scientific Monthly.*

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Hawk Mountain was the high point of the year. It mattered little what they shot or whether they killed it or merely knocked it down to lie helpless and suffering for days on the rocks far below.

Then, foreigners from New York invaded the community and leased the property and sought to bar them from their "sport."

It was into such a situation, accompanied by veiled threats of violence, that the Brouns had the courage to step when Mrs. C. N. Edge, of the Emergency Conservation Committee, asked them to become custodians of the area. How they held off the hordes of hunters, won places for themselves in the hearts of a once hostile community, and built the area into a year-round sanctuary supported by thousands of members famous the world over, is the story of this book. In a very informal fashion Mr. Broun tells of his old pre-Revolutionary stone residence on the side of the mountain. He recounts legends about it and its living ghosts—the wild cave rats—with which they share it. He tells of the changing seasons and the birds they bring, of his "Pennsylvania Dutch" neighbors, and the many naturalists from far and wide who have made pilgrimages to Hawk Mountain.

The final chapters dealing in detail with the remarkable hawk flights will be especially interesting to the ornithologist. After explaining the reasons for the flights and the weather conditions that favor them, the author summarizes his data covering twelve years of flight observation. During that time he has recorded the passing of 179,619 birds of prey, of 16 species. It is possibly a good omen for the future of our much persecuted hawks that 1948 was the best year of all.

We shouldn't assume, however, that one Hawk Mountain sanctuary will solve the problem. Hawks are still slaughtered every fall at many points on the Blue Ridge and elsewhere. Until right-thinking people everywhere rise up in indignation at this wanton and senseless slaughter of some of the finest birds that fly, and display the vision of Mrs. Edge and the courage of the Brouns, our hawks will not be safe.

Richard H. Pough.

NATURE AND ITS APPLICATIONS

- Compiled by Jessie Croft Ellis

F. W. Faxon Company, 83 Francis St.
Back Bay, Boston, Mass.
$17.00, 861 pp.

THIS imposing index is a most valuable tool for anyone wanting "a picture of . . ." The compiler of such a monumental work deserves the heartfelt thanks of librarians especially, as well as of the many artists and students needing to know how things look. The index covers many important sources including the *National Geographic Magazine*, two Encyclopedias, and this magazine. Personally, I would rather have included the *Animal Kingdom* or *Illustrated London News* than the *Woman's Home Companion*. And while I appreciate the value of the three pages of references under "Lion" and the four pages under "Palm Tree," etc., I cannot help wondering how much we will use the eighteen pages under "Animal" and the fourteen pages under "Flower."

Hazel Gay.

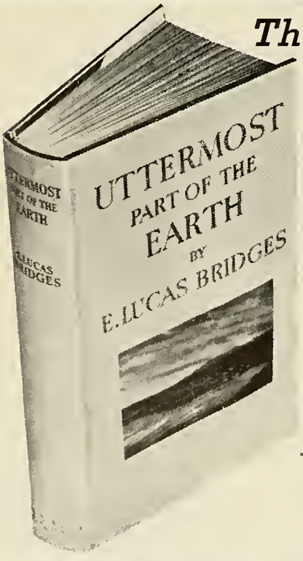
THE WORLD OF LIFE

A General Biology

- - - - by Wolfgang F. Pauli

Houghton Mifflin Co.,
653 pp., 524 figs.

IN this very comprehensive work, Dr. Pauli combines the art of story telling with the concise accuracy of the scientist. His subject matter ranges from the vastnesses of interstellar space to the formidable eugenic problems that now confront man. He not only brings out biology in strong relief from its setting in the inorganic cosmos but also covers its every aspect with a fine regard for time relationships and the evolutionary concept. Also, throughout his broad



The only record which ever could have been written of the little-known savage races of Tierra del Fuego.

WHEN LUCAS BRIDGES was born on that far-off island in 1874, it was virtually an unknown land. Outside of a few settlements of sheepmen, the 18,000 square miles of mountain, forest, marsh and lake was inhabited by fierce and hostile tribes—the Yaghan and the hostile hunters of the interior—the Ona.

Young Bridges grew up among the Yaghan Indians and knew them well. As a young man he gradually built up a friendship with the Onas and eventually learned their language and became an initiated member of their tribe.

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treatment of the origin, behavior, structure, growth, and heredity of living things, he particularly stresses the human history of the concepts underlying them in such a way as to make them appear natural and inevitable, rather than miraculous strokes of genius. In thus humanizing the founders of biology, he inspires the conscientious student to go and do likewise.

In his method, Dr. Pauli strikes a happy medium between oversimplification and a plethora of scientific terms. He is convinced that the former has reached a stage where it either distorts the facts or gives the theories a finality they do not deserve. Some burden, he feels, must be placed on the student himself, who can reap his reward only after hard work and hard thinking.

All in all, *The World of Life*, though not directly applicable to the laboratory, is an excellent portal through which to enter any of biology's specialized fields, and it merits a wide sale and use as a general text book. It is profusely illustrated by photographs and drawings, and the artist, Elmer Smith, is to be highly commended for the clarity and instructive value of his sketches.

George H. Childs.

BEYOND THE CASPIAN

- - - by Douglas Carruthers

Published by Oliver and Boyd
Tweeddale Court, Edinburgh, 22/6
290 pp., 25 illusts.

BEYOND the Caspian gives an intimate insight into a land where few outsiders have penetrated and where still fewer are apt to gain access for many years to come. There may have been changes in the political influences affecting this remote and forbidden land since Douglas Carruthers was there, but the customs of the local people are as ageless as the country itself. Mr. Carruthers has a story to tell—a tale that everyone will enjoy, and he has told it well. He takes the reader to the now almost legendary cities of Samarkand and Bukhara, two of the most intriguing cities that the world has ever known.

Of Samarkand he says, "Samarkand has an atmosphere and character of its own, superior to those of any other Eastern city. It is a beautiful city in beautiful surroundings, a pleasure city as it were, created especially for some super-man, in fact, Timur's throne. Its atmosphere is entirely aesthetic and academic. It exudes—or rather did exude—art, learning and religion. That is its charm."

Here are authentic facts that read like fiction. I can vouch for them because I have been across the same endless deserts and alkali flats, where Mr. Carruthers made friends with the nomads. I, too, climbed up into the rarified air on the roof of the world, where he crossed through treacherous mountain passes, on the trail of some prized specimens. Don't let the fact that *Beyond the Caspian* was written by an explorer and collector of natural history specimens lead the reader to expect just another travelogue and a big game hunt between its covers. It is a colorful, entertaining, and informative exposition of well-chosen subjects that are delightfully refreshing, and it is told with the simplicity and charm of an accomplished writer.

George G. Goodwin.

GEMSTONES

- - - by G. F. Herbert-Smith

Pitman Publishing Corporation, $8.50
537 pp., 44 plates, 145 figs.

THE appearance of the first American printing of this, now standard, work on the stones used in jewelry, marks its return to fill a demand that has long gone unsatisfied. The 9th Edition was printed in 1940 and was a complete revision of a book that had gone through eight editions since 1912. The changes introduced in the American printing are unimportant in comparison with the thoroughness of the revision of the 1940 volume, but they will, nevertheless, add somewhat to the value of the book. The really good news about Dr. G. F. Herbert-Smith's book is that it is again available, after being out of print for the last four or five years.

The first section deals with the physical characters of the minerals used as gems and now includes a long chapter on crystallography, as well as discussion of color, specific gravity, luster, hardness, and the like. An ensuing short section deals with the technology and history of the use of jewelry stones. The principal part of the work discusses the stones that are of chief interest to the jeweler, and following it are shorter sections, now no longer headed "semi-precious" since the phrase is in bad repute, on the less well-known gems. Many of these stones are of interest only to collectors and mineralogists, but it is very gratifying to find them described in some detail in this book. At the same time, this section increases the general interest for nonprofessional readers.

Pearls and organic products that find jewelry application, such as amber, ivory, and tortoise shell, are described in the closing sections. The pages on ivory and plastics are considerably expanded over the 9th Edition. They are appropriate to such a book, which now becomes the only convenient work in which this information will be found. In appendices at the end are numerous tables; specific gravity, compositions, crystal systems, color, refractive indices, and so on, which will be found very useful for reference. A new list of admissible names, as approved in Great Britain is found in this edition.

Will Indian culture survive White domination?

THE INDIANS OF THE SOUTHWEST

A Century of Development Under the United States

by EDWARD EVERETT DALE

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Continued on page 431

PALMS

Princes

TO most of us, palm trees and the tropics are synonymous, and why not, for this amazing assemblage of nearly 3000 species of plants glories in torrid climates and populates most heavily the wet equatorial regions of the world. Actually tropical America is the real paradise for palms, although tropical Asia is also an important center. Brazil, with her endless square miles of wet Amazon country, probably can boast of more kinds of palms—some 500 species—than any other country, though Colombia, too, has an abundant palm flora. Yet there probably still exist hundreds of unknown species in these two countries alone.

So rich is the heritage of our Western Hemisphere in these wonderful plants that a certain group, the palmettos, even wander as far north as the Carolinas, while another group, the honey palms, reach as far south as Chile. In between these, another group, the South American wax palms, instead of moving south or north, climb the vertical slopes of the northern Andes not only past the usual upper limits of palms at 4000 feet, not only past the 11,000-foot timber line, but actually to the unbelievable altitude of 13,450 feet, on the Colombian-Ecuadorian frontier. The remarkable thing is that these wax palms are also the world's tallest palms, often attaining a trunk length of 200 feet, a height that begins to approach that of the lofty California redwoods and Australian eucalypti.

Palms are unique among trees, for of the monocots—that great group with parallel-veined leaves, which includes such plants as orchids and grasses, lilies, iris, and cannas—only the family of the palms has evolved the arboreal type of growth to any substantial degree. Actually palms are not true trees. Except for a superficial resemblance, their trunks are quite unlike those of our common trees, which sport the familiar hard central core of wood which increases in diameter annually and is surrounded by a fairly soft ring of bark. Palms lack a growing layer and scarcely increase the diameter of their trunks, which have a soft spongy heart surrounded by a hard ring of strong

▼ A PALM-GIRT LAGOON has always been a symbol of the idyllic life of the tropics, with food, shelter, and clothing always within reach

Ewing Gallaway photograph

They provide almost every basic necessity of life in many parts of the world and are a promising source of new commercial products in world trade

f the Plant World

By Walter Henricks Hodge
University of Massachusetts

All photographs by the author unless otherwise credited

▲ Its crisp, tender terminal buds make the cabbage palm *(Enterpe)* sought after wherever it grows. A view on the slopes of the central Andes of Antioquía, in Colombia

E. H. Bailey photo

▲ A native genus named after the father of our country: *Washingtonia filifera,* often seen growing along California streets

Bureau of Plant Industry photo

▲ Fruit clusters of a California date palm, one of the many palms that figure prominently in commerce

fibers. Often this outer layer is so tough as to repel the blows of all but the keenest ax. For this reason many a settler clearing a tropical forest spares the palms, for they dull his ax too quickly, and after all, they add beauty to a jungle garden plot.

And for the same reason the fibrous trunks of certain tougher-than-ordinary palms find many constructional uses in hot climes. In the Amazonian settler's shack split palm trunks take the place of oak flooring, for they resist termite attack and are more lasting than any other material. Trunks of the palm called chonta (*Guilielma*) are filled with some of the toughest yet flexible black fibers known. For this reason the species is much in demand and is even semicultivated by lowland Indians of South America for the construction of bows, spears, daggers, blowguns, and blowgun darts. The wood of this abundant and easily grown palm is awaiting an enterprising sporting goods manufacturer who is looking for a flexible yet strong wood for such arti-

◄ **Climbing** the Cuban royal palm for the cabbage bud and for leaves for thatch. Of all the royal palms, the Cuban is the most beautiful

▼ **All over** the moist tropics, a palm hut is the favorite native home. This Cuban *bohio* is made entirely from various parts of the Cuban royal palm

◄ **Waterproof and well ventilated**: a roof shingled with palm thatch in the lowlands of northeastern Peru. Constructed of materials readily available without cost, such a building will solve the housing problem for a quarter of a century

cles as fine fishing rods and the like.

With but few species growing in temperate latitudes, it is small wonder that palms are strangers to most civilized peoples, who grow up rather with oak trees, pines, or maples. The potted infant palms in our florist shops give little idea of the majesty of the mature trees, and it is only after a trip to the sunny southland that the winter visitor can really appreciate the palm's stately beauty. And who does not gasp at his first glimpse of savannas peppered with stubby palmettos, of seacoasts girt with wind-combed coconuts, or busy city streets colonnaded with the slaty shafts of royal palms!

Scarcely a dozen of the several hundred species of palms grown in the warmer parts of the United States are natives, and of these the majority reside in subtropical Florida. Most of the palms that rattle their leaves along the parkways, that enhance our southern homes, or skirt our subtropical sea beaches are immigrant exotics; yet in their native homelands they claim a vast range of habitats. Depending upon the species, they revel in bright sun or dense shade, in swampland or desert, prairie, seacoast, or mountain.

If Mr. Average Man is unfamiliar with palms in nature, he is just as unfamiliar with their many economic products. To him coconuts and dates are everyday novelties of the corner fruit store or ingredients of a favorite cake or pudding. But little does he realize that in their countries of origin certain palms constitute the very staff of life of the people. In the realm of economically important plants, palms stand second only to the grain-yielding grasses.

⮝ THE AUTHOR'S WIFE holds up a newly described species of *yanga (Geonoma),* a small palm from the mountain rain forests of Dominica. Its leaves were used for thatch by the Island Carib Indians—the "cannibals" of Columbus' voyages. The pea-sized fruits are seen at right

⮝ PALM FLOWERS and fruits push out of curious boat-shaped spathes *(left foreground),* which are usually hidden at the base of the giant leaves

Thus throughout the Pacific isles the coconut (*Cocos nucifera*) is king—indeed, with over 1000 uses, it is one of the world's most important trees. In its island habitat the coconut is always found close to the sea. Conditions there are best for its development, and it flourishes in greatest luxuriance a few feet above high water mark. Under cultivation, it can be found at great distances inland, even at an altitude of 2000 feet, but in such places nut production falls. The results are similar when the species wanders into the subtropics. Hawaii's coconut palms of precivilized times yielded such poor crops that the fruit was a luxury for the privileged males. Woe betide the woman who dared touch it.

Humans have greatly increased the territorial domain of this palm. It has become so closely linked to agriculture that, like many another long-cultivated and protected plant, it has lost whatever aggressiveness it ever possessed and succumbs easily to any choking undergrowth. How real this plant-man partnership has become is reflected in a Cingalese proverb, which avers that "the coconut will not grow out of the sound of the sea or the human voice; nor will it thrive unless you walk and talk amongst the trees."

For such care, the coconut gives bountifully. The ripe meat and its many uses are too well known to list, yet in the Pacific isles the fruit is not used so much by people as by livestock. All domestic animals get their coconut meat rations. Guam natives use this natural food to fatten up a delicacy, the abundant land crab. If fresh coconut meats serve only the livestock, the milk serves only the people and is, on many a tropic isle, the only beverage of the natives.

The coconut can boast the original sealed milk bottle, for what container could have been more convenient or durable on a long sea trip than nature's own tough coconut bottle? Pacific islanders have for years kept their boats stocked with this sealed water supply for emergencies. And perhaps the Spaniards, on their early sailing trips from the Philippines to Mexico, copied this Polynesian habit, thus introducing the coconut to the western shores of the New World.

Bligh's memorable voyage in the "Bounty's" lifeboat might not have been successful without the nourishment provided by the nut. In his journal one can find such descriptive entries as: "May 6, 1789: our allowance for the day was a quarter of a pint of coconut milk, and the meat, which did not exceed two ounces to each person: it was received very contentedly . . .; May 9, 1789: in the morning a quarter of a pint of coconut milk . . .; and for dinner, I divided the meat of four coconuts, with the remainder of the rotten bread."

The coconut attains its greatest marketable value as copra. Indeed, in Polynesia this palm product is the only export of commercial value. Nuts to be used in the copra trade are allowed to mature on the tree. When they fall, the meat is pried out and allowed to dry in the sun on mats or platforms. The copra finds its way to the world's manufacturing centers to be converted into a large series of fatty products. The United States normally uses 20,000,000 pounds annually.

Natural oil, to the tune of 50 per cent of volume, has elevated copra to a station where the crop can practically never be overproduced. Butter-starved postwar Europe craves copra by-products for conversion into butter substitutes, while America uses them for soaps and oleomargarines.

Use of soap and oil obtained from copra originated in the Pacific islands, where for centuries the natives have anointed their bodies and hair with Macassar oil. Mixed with sandalwood, the same oil imparts fragrance to the hair of island beau-

◄ A FINE COCONUT PALM at Trinidad, British West Indies

L. H. Bailey photo

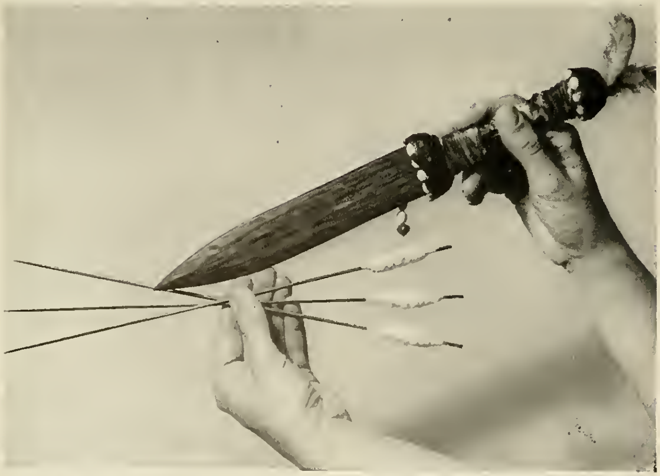
▼ IT IS in certain parts of the South Pacific that the coconut palm reigns supreme. Here is a shipment of coconuts from Tuamotu. The United States alone imports 20 million pounds of dried coconut meat yearly

AMNH photo

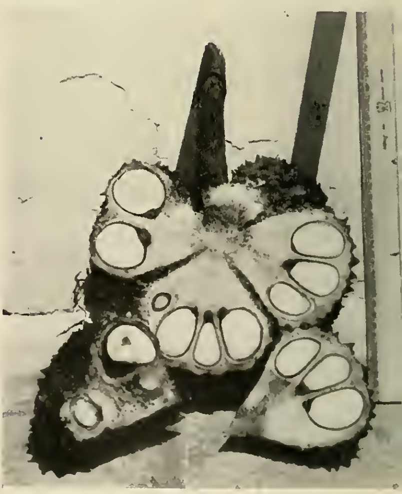
ties—apparently the fragrance that inspired one writer to remark: "Among the islands of the Pacific the smell of rancid coconut oil always brings to mind visions of brown-skinned natives and thatched roofed huts nestling beneath groves of coconut palms."

Milk, copra, and the tough, elastic fibers known as coir all come solely from the coconut fruit. If any other plant offered this variety of economic usables, we would call it important; but the coconut palm doesn't stop with these mere fruit derivatives. It offers as further proof of its usefulness additional products made from every conceivable portion of its vegetable body.

The single terminal bud makes an excellent salad. The beverage toddy is fermented by the Pacific natives from sap tapped from young flower spathes. Leaves, besides being the chief roofing thatch, are also woven into hats, baskets, and mats,



▲ THE WOOD of some palms is so hard as to resist all but the keenest ax. These are weapons of chonta: a ceremonial dagger and three blowgun darts tipped with curare and wrapped with kapok floss to fit the blowgun



▲ BUTTONS and various articles of artificial ivory are made from the hard white seeds of the tagua palm *(Phytelephas),* whose fruit clusters are shown here in cross section or are made into brooms or torches. Imported "porcupine wood" is hard and handsome, excellent for cabinet work and veneers; in its homeland it is part of a coconut trunk.

What a tree is this palm! Picture just one day in the life of a Polynesian: a morning coconut oil massage; rations of coconut mash for the domestic animals; a full-course dinner with coconut milk entree, coconut-fattened crabs in a salad with fresh coconut buds, served on platters fashioned from coconut shell, followed by a dessert of coconut pudding. After dinner comes conversation in the flicker of coconut oil lamps, which illuminate the faces of a household reclining on coconut mats in their shelter fashioned from coconut wood and thatched with coconut leaves. Outside, serenely nodding over all, what should one find? Why, of course, a coconut palm!

Dates are to the Arab equally essential, and on the size of the harvest from the date palm may depend the wealth if not the very existence of many a desert tribe. But each tropical region can boast of its own palm favorite. In northern South America it is the *pejibaye*, or peach palm, with an edible fatty fruit. In Malaya there is a palm triumvirate, which includes the palmyra with over 800 uses, the starch-producing sago palm, and the much chewed betel-nut palm. In Cuba the superbly beautiful *palma real* (royal palm) is protected by law, for the peasants derive from it a home, the simple native *bohio*, hewn from its timber and thatched with its leaves, while they are occasionally fed by its bud.

Little do we realize the part palms play in each one of our own daily lives. Brazil helps to keep our streets clean by sending us the coarse bristles from the leaf stalks of the piassaba palm for the brooms of our cities' "white wing" departments. From the island of Madagascar comes raffia, the soft, dried leaf tissue of a palm that is important for its use in basketry. From the strong flexible stems of certain high-climbing palms of faraway Malay is derived rattan, woven into baskets, furniture, or the cane seat of the chair you may be using at this moment. Add the palm oil in Palmolive soap, which comes from the crushed nuts of the west African oil palm; the shredded coconut in your

AMNH photo

▲ THE SILHOUETTE that spells romance and gentle living: a palm-shaded hut on the Yasawa Islands, Fiji, with the Whitney South Sea Expedition schooner at anchor

▲ CARVED from the vegetable ivory of the tagua palm: the likeness of Sucre, liberator and national hero of Ecuador

wife's layer cake; and the fat in oleomargarine with its copra origin. The powdery protective wax that covers the leaves of Brazil's carnauba palm gives strength to your favorite phonograph record and imparts a high protective polish to your waxed floors and automobile. The buttons on your new dress are of vegetable ivory, machine-cut from the tough seed of Ecuador's ivory nut, or *tagua* palm. And the resinous substance called "dragon's blood," obtained from a Sumatran rattan palm, is a constituent of the very finest varnishes. Why, we can't get away from palms!

Although the commercial fibers and waxes obtained from the leaves of various palms are of greatest value to us, the most important single function of palm leaves throughout the whole great range of their growth is as thatch. Palm leaves become the shingles of practically all primitive tropical homes. This is due to their universal availability and general imperviousness to water. On numerous instances, while on a tropical trip of plant exploration, my native guides have whipped up an overnight shelter in five minutes merely by cutting down an ever-present palm and properly arranging the cut-off leaves over a thatching pole. Even in the heaviest tropical downpour, one can be snug and dry under such a crude palm-leaf shelter. More permanent tropical dwellings are more carefully thatched, the roofs being woven together with all the care and technique used in making a finely woven basket. Such native thatching will shed water for years and is cool, in addition. Even the white man accepts this as the best in tropical roofing.

Besides keeping one dry, young palm leaves are an excellent emergency food everywhere in the moist tropics. The edible portion is the palm bud, or so-called "cabbage." Like a cabbage—though a cylindrical one—it is made of tightly packed young leaves that are tender, crisp, and white. The innermost ones are naturally the choicest, having the flavor of cabbage—hence the name. They may be eaten either raw or cooked. Certain palms, especially the so-called cabbage palms (*Euterpe*), have particularly delicate buds, but almost any palm bud may be eaten. To taste palm cabbage, just fell any palm tree; the plant will be killed, but in a food emergency anything goes.

Despite their long association with man, palms are perhaps less completely known than any other group of flowering plants. This is partly due to the very local occurrence of certain species. Many a tiny island or an isolated mountain valley boasts of a native palm unknown elsewhere. But the chief reason why we do not know them better is that most palms are so tall that botanical study is rendered difficult. To classify new plants, the great botanical museums of the world must acquire pressed specimens of each species for study and permanent reference. Most plants in one way or another can be fitted into an herbarium case on a standard size (11x16-inch) paper mount. But not palms. Think of yourself as an exploring botanist charged with pressing ample material of, say, a talipot palm, whose leaves may be 25 feet long, to say nothing of the gigantic flowering branches. You would probably just forget it, and that is what many a field collector has done. This has resulted in a number of strange situations, and many of these plants, seemingly common enough—often even growing at a botanist's doorstep—have proved to be entirely new to science. For instance, on the tiny British Caribbee isle of Dominica there grows abundantly a cabbage palm locally called *palmiste,* which has been illustrated on local postage stamps for years. Yet no scientist had ever studied this palm until 1940, when it proved to be an entirely new species!

Facts like this have stimulated the interest of at least some professional botanists, who are determined to give palms the careful study they truly merit. The most celebrated student and collector of palms of our times is a nonagenarian, the very distinguished dean of American horticulture—Professor Liberty Hyde Bailey, who after completing a full and active life at Cornell University decided to study palms. At an age when most individuals are sitting at home, basking quietly in retirement, Professor Bailey may be found doing what is even tough for a young man —climbing tropical mountainsides or penetrating the Amazonian jungles in the search of palms, old or new! Since his "retirement" he has built up at Ithaca one of the largest and best herbarium collections of palm specimens to be found in the world. Dr. Bailey's distinguished studies on this group have been honored by a monument of living palms growing in the famed subtropical Florida garden of an equally distinguished botanical explorer, Dr. David Fairchild, who has also been a devoted student of the palms.

Despite the trouble they give the collector, not all palms are giants. Certain palmettos of the Florida pinelands and of the West Indies are dwarfs scarcely three feet high, with no trunk at all. And not all palms are trees, for Malayan rattans are scrambling vines that clamber upon forest trees often to a height of 200 or 300 feet. But the majority of palms assume the conventional aspect, with straight unbranched trunks topped by feather dusters of large clustered leaves.

Actually the leaves of palms are regularly shed below as new young ones appear at the top, where they are formed by the all-important single terminal bud that is buried deep in the feathery-green crown. Along the many streets where palms have been planted, pedestrians will do well to keep an alert eye for old falling leaves, for a single leaf of, say, a royal palm may easily weigh more than ten pounds —no joke if it lands upon an unsuspecting head. And speaking of royal palms, whose trunks often look like columns of poured cement, a lady visiting a tropical garden for the first time is said to have asked in all earnestness how and why they ever planted those green plants so high on those cement pillars!

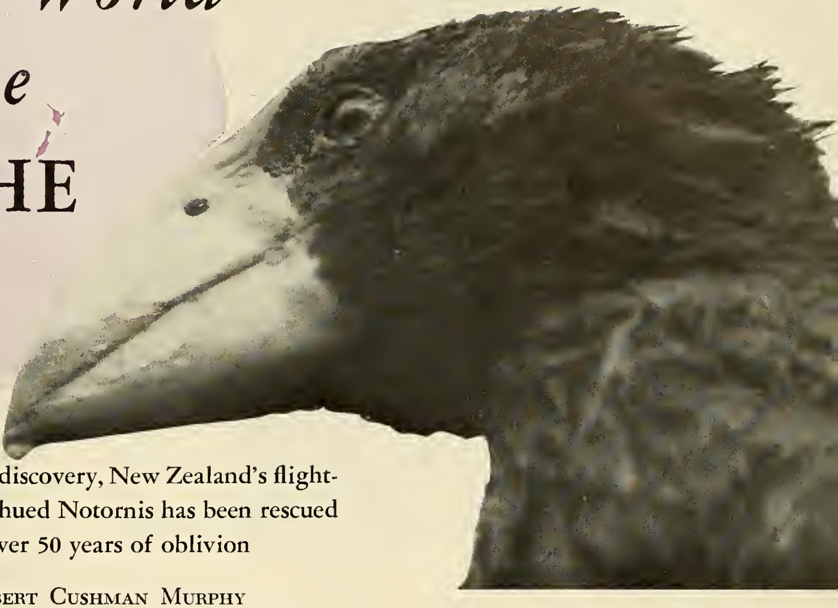
Even the novice can distinguish

Continued on page 429

The Lost World of the TAKAHE

In a dramatic rediscovery, New Zealand's flightless, brilliantly-hued Notornis has been rescued from over 50 years of oblivion

By ROBERT CUSHMAN MURPHY
Lamont Curator of Birds, American Museum of Natural History
Photographs by GEOFFREY ORBELL and CARL C. SORENSEN



▲ CLOSE-UP of the head of the Notornis

THE hope of discovering plants, animals, human beings, or handiwork pertaining to a closed epoch has always exercised a peculiar fascination. It is the theme of Conan Doyle's *Lost World* and of Hudson's *Green Mansions*. It is the quasi-reality behind credence in sea serpents, the reconstruction of imaginary continents such as Moo and Atlantis, and the currently reported search on Mt. Ararat for timbers of the Ark!

Recently, two actual finds of this category have stirred popular imagination the world over. The first was the capture off the South African coast of a fish, *Latimeria*, related only to lobe-finned relatives that have been extinct for scores of millions of years. The second was the rediscovery of a bird, the takahe (*Notornis*), which had lived into modern times but of which only four specimens were known. The last of these was collected in 1898. It is noteworthy that *Latimeria* was recovered from remote depths of the sea and *Notornis* from New Zealand, its only known home and the most remote and isolated of our earth's temperate land masses.

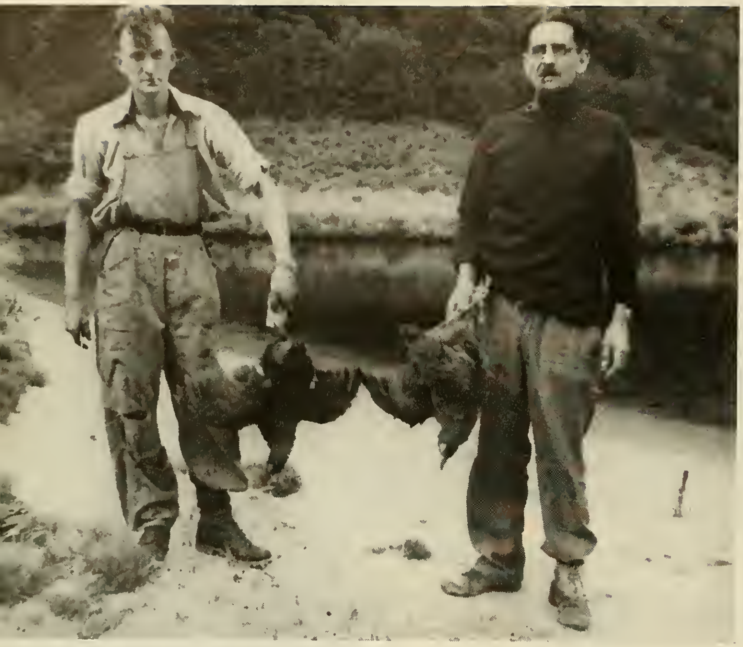
The takahe was first recognized and described in 1848 from skulls and other bony fragments found in postglacial deposits of North Island. The Maori aborigines knew the bird when Europeans arrived, but not until 1851 did an example in flesh and feathers come into scientific hands and the post-mortem security of the British Museum. The subsequent history of the species was sketchy because the bird was rarely seen, and only three more were taken and preserved during half a century. Two of these went to Europe and one remained in a New Zealand institution, the Otago Museum of Dunedin, where it is still exhibited. Few if any of the world's naturalists, with the fate of the moas in mind, believed that a takahe would ever again cross life's stage.

What Is It?

The takahe is a large rail or gallinule, flightless though not wingless, brilliantly blue, indigo, and green in the hue of its silky plumage, and equally gaudy in the reds of its large bill and big-footed legs. It is a bulky relative of another and still common New Zealand bird, the strong-flying pukeko or swamp hen, which every traveler sees as he passes through the countryside.

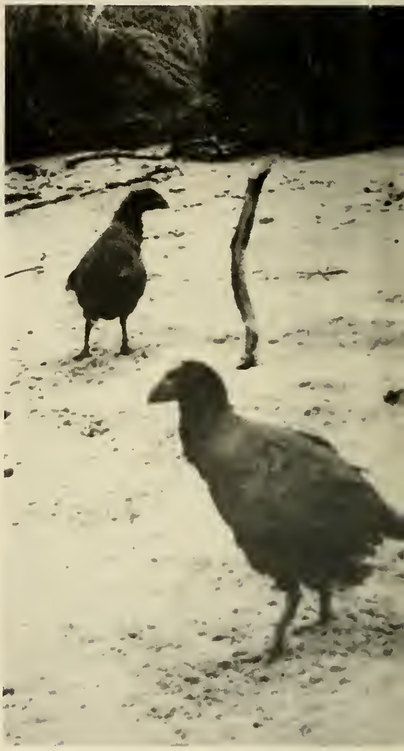
Among land birds, rails have shown an exceptional ability to populate distant oceanic islands, even very tiny ones. From tropical Pacific areas the pukeko reached New Zealand under its own power and within modern times. We can be certain of the latter assumption because, although it far antedated the coming of white men, its traces have never been found among the abounding subfossil skeletal relics of New Zealand swamps and limestone fissures. If it were a truly ancient bird in the country, the evidence could not have been concealed.

Perhaps we should think of the



◄ Mr. Neil McCrostre and Dr. G. B. Orbell with two of the living birds

▼ The two birds on the lake shore. Their homeland is one of the most inaccessible sections of New Zealand



takahe as the scion of a very much earlier pioneer, that is, a flying immigrant belonging to the same general stock as the pukeko. Later, in the complete absence of predaceous mammals and reptiles—the outstanding ecological characteristic of primitive New Zealand—it could afford to grow big and flightless.

Until the coming of European settlers with their devastating satellites such as pigs, dogs, cats, and rats, and the predatory wild animals like stoats and weasels, which they also introduced from Britain, the takahe found plenty of safe retreats among high mountain valleys surrounded by dense forests of antarctic beech.

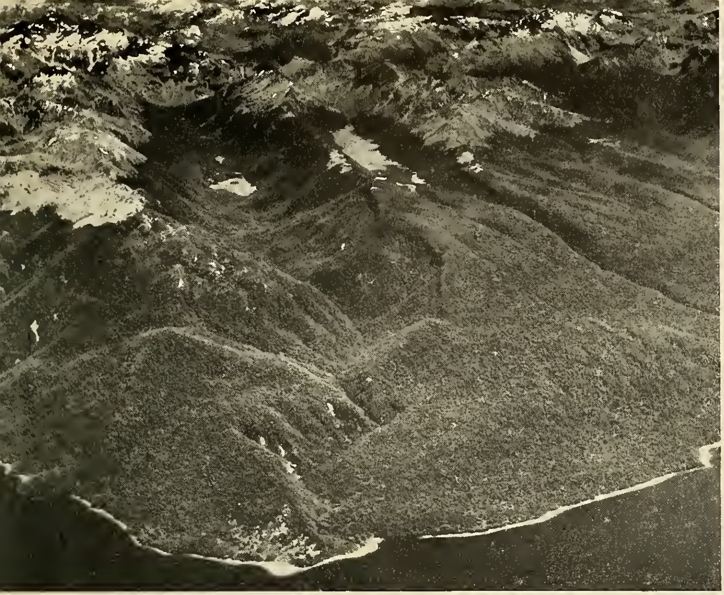
The Rediscovery

New Zealand is a land of enthusiastic and competent amateur naturalists. One of them, Dr. G. B. Orbell, a physician of Invercargill, cherished at least a half belief in the continued existence of the takahe in the fastness of all but inaccessible wooded ranges of the South Island Alps. He had long collected every available account and rumor, old and new, and in the New Zealand autumn (April) of 1948 he set forth with a group of companions from the western shore of Lake Te Anau into the pathless forest.

The nature of the New Zealand wilderness deserves a word of explanation. In the southern half of South Island the moisture borne by westerly winds from the Tasman Sea is precipitated by the mountains to such an extent that certain areas receive annual rainfall of 200 inches or even more. This, combined with the ameliorating influence of the ocean around an island considerably smaller than Britain, produces an unexpectedly mild climate. The result is that New Zealand forest, or "bush," as the residents call it, bears a strong resemblance to tropical rain forest, even in a latitude corresponding with that of Montreal. Great trees stand close together, and the shrubs, ferns, mosses, lichens, liverworts, lianas, orchids and other epiphytic growth not only give a strange and elfin aspect to the woods but also make progress in trackless areas extremely slow and difficult.

At Lake Te Anau, which extends north and south for 35 miles in a drowned valley, the contrast between the primitive wilderness and the country that has been conquered and utilized by man is very marked. To the east, the forest has been largely felled, and there are now extensive areas of grassland devoted to sheep and cattle range and in part to agriculture. To the west, on the other hand, the territory is still virgin and uninhabited, and arms of the lake penetrate the adjoining poorly explored Fiordland of the west coast.

It was into this terrain that Dr. Orbell struck, working his way



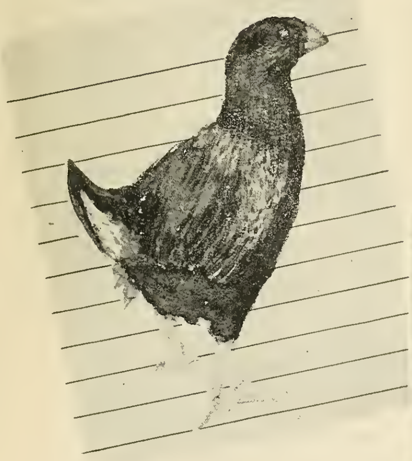
▲ An aerial view of the two wild valleys where the takahe has been rediscovered. The explorers made their way up the gorge from Lake Te Anau, at bottom

through the forest to an altitude of nearly 2700 feet, until he found a hidden valley and lake, unrecorded on any map but agreeing with descriptions he had received from old Maoris and frontiersmen. On this first visit the party heard only an unfamiliar bird voice and obtained an impression of a footprint in the mud, which was subsequently identified as that of *Notornis.*

Armed with such encouragement to his growing conviction, Dr. Orbell and three companions returned to the same region in the following spring (November), carrying cameras and 50 yards of fish net. On this occasion his enthusiasm was rewarded by sensational success. He obtained numerous photographs, including those that illustrate this article, together with a reel of 8-mm. color film that we subsequently had the pleasure of viewing during the sessions of the Seventh Pacific Science Congress in February of this year. He also captured two adult birds, by surrounding them with the net, for close examination and measurement. Both, of course, were later released and, as Dr. Robert A. Falla, Director of the Dominion Museum at Wellington, has written: "It is significant of a healthy advance in public as well as scientific sentiment that no one has demanded a specimen to prove" the rediscovery of *Notornis.*

The Takahe's Way of Life

Some time after the cabling of the news to the outside world, where it was received with extraordinary interest, as evidenced by the amount of publicity in the press, Dr. Falla was commissioned by the New Zealand Government to join Dr. Orbell and other members of the original party in a third investigation of the takahe and its environment. This trip was made last January and involved the setting up of a camp in the valley. Dr. Falla has been so kind as to put a copy of his unpublished notes in



➤ Dr. Robert A. Falla, sketching the bird while Dr. Orbell holds it. Adjacent is one of his field drawings the hands of the present writer. To these we are indebted for most of the information in the following paragraphs.

The homeland of the takahe is in glacial valleys clothed with coarse grasses and wiry scrub that offer little abundance or variety of food to bird life. The same is true of the surrounding beech forest, where the floor is thick with moss. The streams and lakes, dammed up by morainal material in these valleys, likewise appear to harbor singularly little plant and animal life. Keas, or mountain parrots, on the neighboring ridges, a few pipits, the kiwi, and several species of New Zealand ducks are almost the only native fellow residents of the takahe, which is apparently the dominant species of the association.

The takahe proves to be exclusively a vegetable feeder, thus sharing the browsing and grazing habits of the many extinct species of moa. It was observed to strip the flowers and seeds of snow grass (*Danthonia*) by running its powerful bill along the stalks from base to tip. Bundles of sedges were pressed to the ground with one foot and uprooted with grubbing strokes of the beak, after which the succulent bases were bitten off. Even the fleshy stalks of a spiny and forbidding New Zealand plant known as the Bloody Spaniard (*Aciphylla*) were devoured after the sharp and thorny leaflets had been picked off one by one. Dr. Falla infers that a diet thus restricted would require the consumption of such large quantities of plant food that a *Notornis* population might have a strongly modifying effect upon the vegetation of any limited area. He adds in his notes that if the "moas had similar habits, and there is good evidence that they had, the native vegetation formerly must have been subjected to browsing and grazing pressure of considerable magnitude."

The ground-built nests, the eggs, and the black, downy chicks of the takahe were all discovered during this January, or midsummer, visit. About 30 nests of the season were examined, but it is not known that they were all occupied because it is a habit of gallinules to construct several nest platforms. It appeared probable from observation that most breeding pairs of the takahe succeed in rearing only a single chick, but it is uncertain whether this is due to the birds' inability to save more than one from predatory enemies or whether it is a natural response to the rigors of the habitat and the paucity of food in relation to hearty vegetarian appetites. The total population of takahes in the neighborhood of the camp was not accurately determined, but it is believed that two adjacent valleys may have supported colonies totaling between 50 and 100. Twelve or fourteen different adult birds were actually seen by members of the party.

◄ THE FIRST WHITE WOMAN to hold a Notornis: Miss Joan Telfer taking the bird from the net

Not until this summer (the New Zealand winter) was it learned how the hardy takahe fares during the season when the South Island Alps are snowbound. A party that included Mr. E. G. Turbott, a leading ornithologist of the country, broke its way into the high valley on August 22, finding signs of seven takahes and sighting two.

It appeared that in winter the birds wander rather widely over the snow, seeking shelter and food in the fringes of the beech forest, to which they may be largely confined throughout the periods of northwesterly weather that bring the heaviest falls. Each such cycle is preceded, however, by a strong thaw, and at such times the birds promptly return to the open country to feed upon the re-exposed snow grass.

The Future

Official New Zealand responded with dramatic thoroughness to the takahe's need of the most rigid possible protection. Here, it seemed, was an opportunity to atone in part for the ignorance or lack of foresight that had led to the loss of so large a proportion of the native fauna and flora.

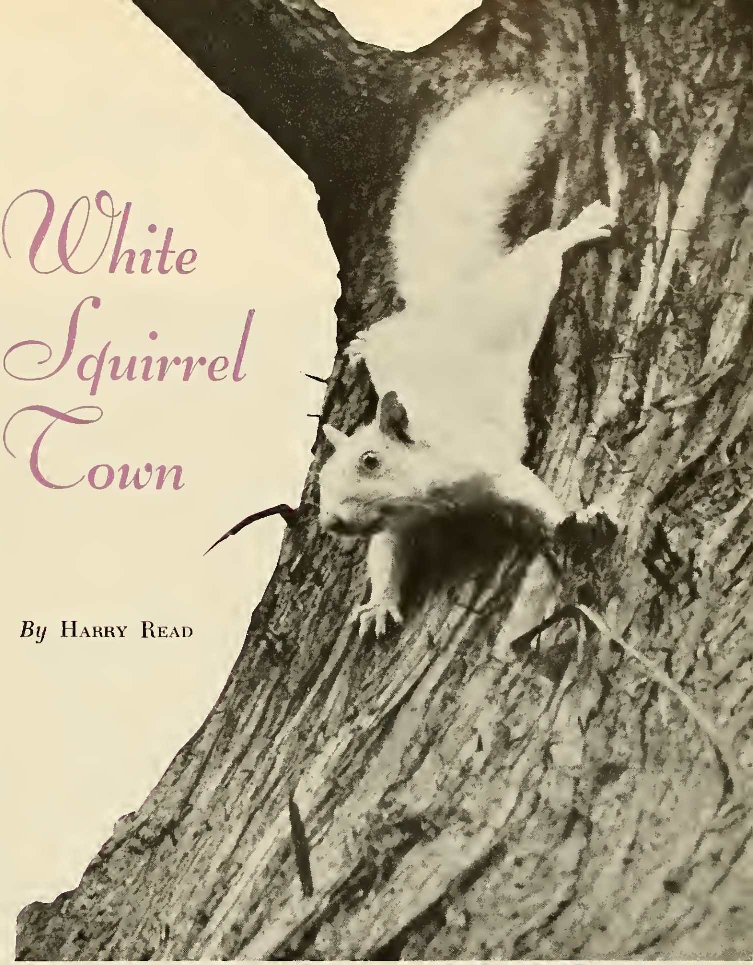
Within a month after the discovery, the Government proclaimed a closed sanctuary of 400,000 acres to afford inviolability to the mere 500 acres, more or less, in which the living birds were found. Regarding the next steps in the program, Dr. Falla has written:

"As far as the Te Anau colony is concerned, it is imperative to ease the predator pressure or prevent it from increasing; and a plan for this already is being operated by officers of the Department of Internal Affairs. The possible existence of other colonies also is being investigated, and with the present active revival of exploration in Fiordland, and the fact that takahe country and unmistakable traces of the birds can now be recognized easily, results may be expected."

Perhaps the long-delayed rescue of the bird from oblivion may prove to be the blessing that will enable us to keep it forever.

White Squirrel Town

By Harry Read


Null's Studio photo

▲ One of Olney's many distinguished citizens

OLNEY, Illinois, 250 miles south of Chicago, is popularly known as "The Home of the White Squirrel." And the claim is no idle boast, because nearly 1500 perfectly white squirrels are estimated to live there. They can be found at any residential point in the city, being perhaps more numerous near the city park in the lightly populated northern edge of Olney.

The first white squirrel was discovered about 1902 near Sumner, Illinois, 20 miles east of Olney. Mr. George W. Ridgely saw one in the woods near his home south of Sumner. It disappeared for a short time but reappeared with a cream-colored mate. Mr. Ridgely wanted to trap them and tried to enlist the aid of a neighbor, who, since he had not seen one of the white animals, promptly remarked that Mr. Ridgely was either drunk or crazy. However, after several fruitless attempts the squirrels were captured in a trap rigged in a limb den. Mr. Ridgely kept them for a while and then sold them to a saloon owner, Mr. Jap Banks. Banks exhibited them in his window until a state act made it illegal to keep wild animals in captivity for display purposes.

The squirrels were given to two boys and permitted to run loose. The male was killed, but the female raised a litter. From then on, the animals bred and thrived steadily. They will interbreed with gray squirrels but not with the larger fox or red squirrel. Progeny of a white and a gray squirrel is usually gray or white or any shade between.

At various times, pairs of the animals have been taken to other sections of the country, but so far as is known they have never multiplied elsewhere. Battle Creek, Michigan, is noted for black squirrels, but a deal whereby the two cities would exchange their specialties recently fell through.

We are assured that these white squirrels are the albinistic form of our common gray squirrel. The fact that they will interbreed freely with the gray squirrel while not mixing with the fox squirrel helps prove this point, according to Mr. T. Donald Carter, of the American Museum's Department of Mammals. The photograph, he adds, also shows this to be the case.

"Albinistic or white gray squirrels occasionally appear anywhere within the range of the gray squirrel," states Mr. Carter, "and at times a colony of albinistic animals becomes established, as has occurred at Olney. Ernest Thompson Seton, in his *Lives of Game Animals,* mentions such a colony at Greenwood, South Carolina. He states that in 1916 there were about 100 white squirrels in this colony and that they had been observed there for about 22 years. Another colony, which I personally visited, was at Bloomfield, New York, not far from Canandaigua. I do not know if this colony is still in existence. At the time of my visit, about twelve years ago, there were a number of white gray squirrels about the town.

"The black squirrel, which is common in certain sections of the northern states and Ontario, is the melanistic form of the gray—the opposite of an albino. In certain sections, this black form is more commonly seen than the normal gray. In northern Bronx in New York City, the black are not rare and in a few places are as common as the gray."

In Olney, Illinois, the pure white squirrels have become domesticated to the extent of frolicking on lawns and eating from the hand, and they are protected both by an Illinois law and a city ordinance.

The Strength of the Cattail

THOUGH outwardly familiar to all, the cattail offers a
urprising illustration of strength with lightness to any-
ne who dissects it with a razor blade

ng Galloway photo

Ages before man's development of engineering science, Nature produced the "patent model" for an airplane wing

By EDWIN WAY TEALE

Photographs by the author except where otherwise credited

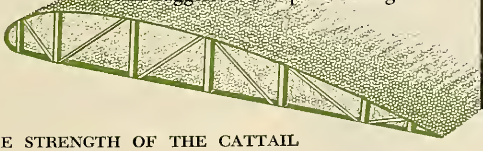
WHEN gusts sweep across a cattail marsh on a windy day, the slender green leaves twist, flutter, bend, and gyrate. But they rarely break. And when the wind dies down, they return to their former position. Although such leaves may rise 100 times their width and more than 500 times their maximum thickness, although they are feather-light and partially filled with air, they are able to withstand innumerable stresses and tensions. The cattail leaf represents a marvel of Nature's engineering.

The secret of its strength lies in its internal construction. Cut across a cattail leaf with a razor blade—either a broad-leaved cattail, *Typha latifolia,* or a narrow-leaved cattail, *Typha angustifolia*—and what do you find? You discover a remarkable system of internal bracing comparable to that of an airplane wing. Millions of years before the Wright brothers flew at Kitty Hawk, Nature devised the maximum lightness and strength construction of modern aircraft design.

In the series of photographs on these pages, you find some of the similarities between leaf and wing. Not only does the cross section of the leaf show a construction almost exactly like that of the ribs of the earliest airplanes, but the camber and thickness of both wing and leaf decrease from base to tip. Six cross sections, taken at different points along a latifolia leaf five-eighths of an inch wide and seventy-two inches long, are shown in one of the photographs. The series, showing the internal construction of the leaf at various distances from the base, reveals how the leaf, like

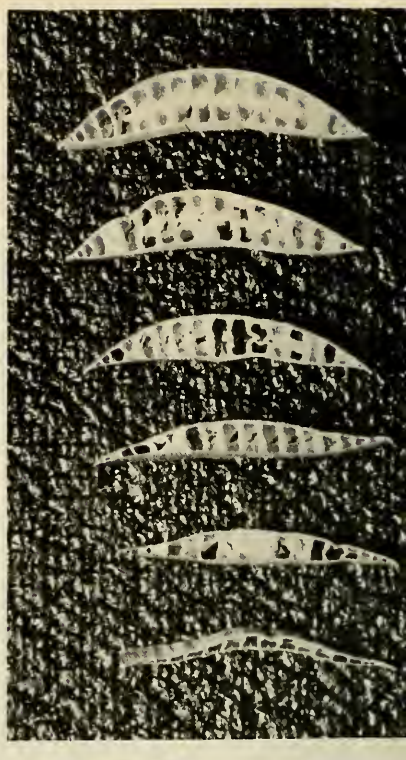
▲ THE LEAF can be bent like a bow without being broken, despite its featherweight construction

➤ CUT A SECTION out of a leaf and you will find an internal construction suggestive of a plane's wing



the conventional airplane wing, grows thinner and less convex as it approaches the tip.

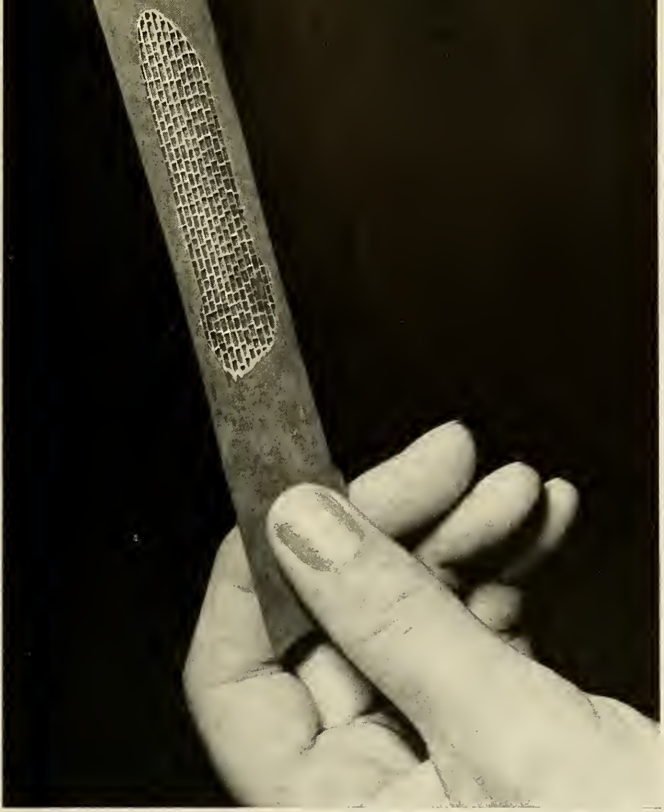
Running the full length of a cattail leaf, from base to tip, are veins that are comparable to the longitudinal spars of the aircraft wing. Inside the leaf, if a section of the top is removed with a razor blade, you discover innumerable cells, their walls forming a mesh or open network. These cells can be examined from the side by splitting the leaf vertically and folding back the two halves. This framework of open cells, in staggered rows, is an important feature in providing the leaf with the greatest strength for the least weight.

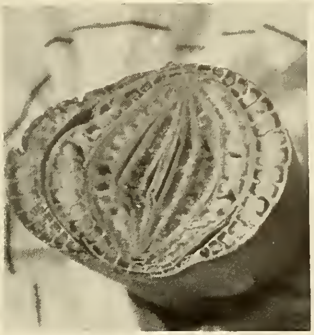


▲ SECTIONS at intervals of about a foot show that the leaf becomes less curved and thinner toward the end, just as an airplane wing does

For nearly 20,000,000 years, the cattail leaf has been making use of this construction. Curiously enough, although this water plant has been on earth so long, it forms one of the smallest families of flowering plants, having but a single genus. Two species are the familiar, widespread *Typha latifolia* and the narrow-leaved *Typha angustifolia*. The latter is confined to calcareous regions inland and brackish waters near the coast. At one time, the leaves of this cattail were harvested for making paper and for sealing watertight casks. The dried leaves were inserted between the staves.

▲ SO STRONG are the leaves that in a high wind they will only lean and then return to their normal position. Sometimes the roots will be upturned before the leaves break. *(Typha angustifolia)*





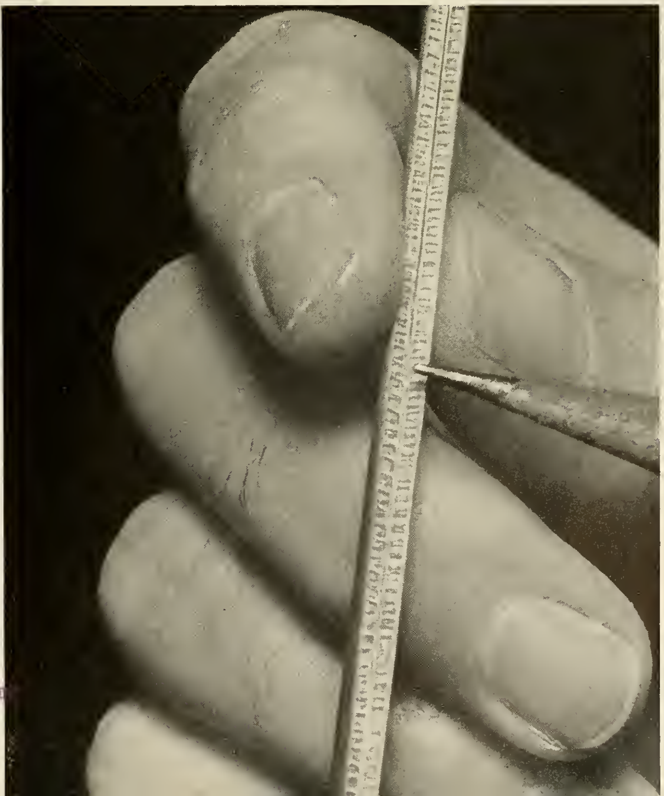
▲ A CROSS SECTION through the bundle of leaves near the base shows how the cell construction develops

◀ SLICING OFF the surface of the leaf reveals a system of hollow cells separated by lengthwise and crosswise braces. This picture is of *Typha latifolia*

▼ THE SAME LEAF, when split lengthwise and folded back on itself, shows the crosswise divisions that reinforce the longitudinal ones

Later, when the container was filled with fluid, the leaves swelled to form a perfect sealing at the seams. It is the air-borne seeds that spread the cattail over wide areas. Once established, however, the perennial roots continue to advance, so that a stand of cattails an acre in extent often represents only a few plants.

Paradoxically, the strength of the cattail leaf occasionally proves a disadvantage to the plant. Cattails are pioneer land builders. Their interlacing roots push out into deeper water along the edges of shallow ponds. Advance clumps, insecurely anchored, sometimes meet disaster when they are capsized by the wind. The internal bracing of the lightweight leaves is sufficiently strong to withstand the gusts. They bend but do not break, and in this straining tug of war it is the massed roots below rather than the leaves above that give way first.

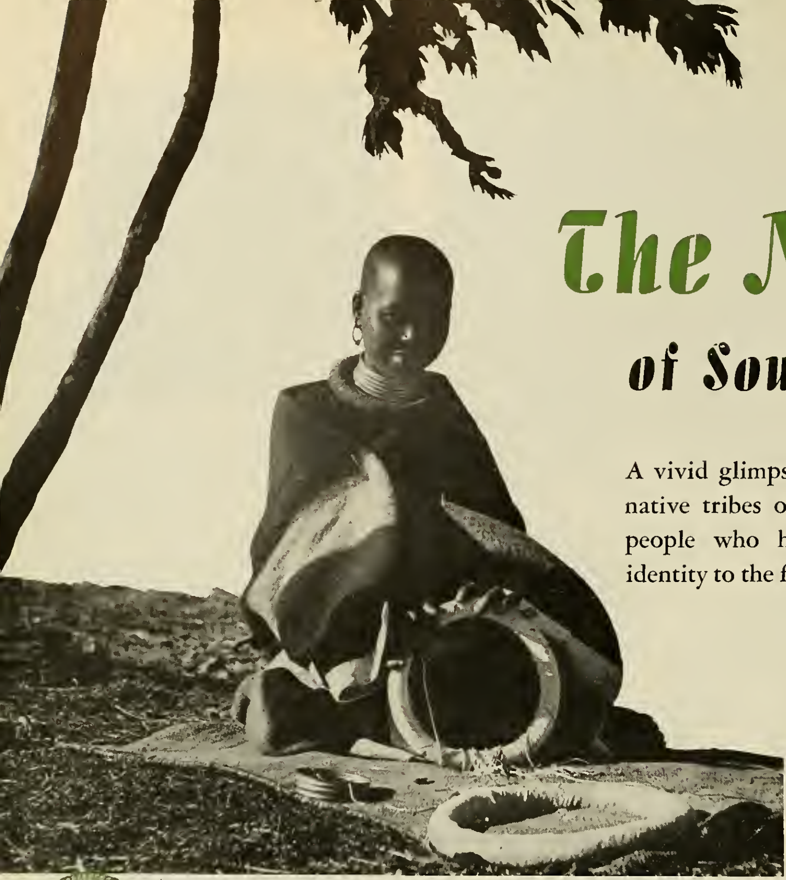


The Ndebele of South Africa

A vivid glimpse of one of the least-known native tribes of the Transvaal—a colorful people who have not surrendered their identity to the firm grasp of Western culture

By I. SCHAPERA
University of Cape Town

Photographs by
CONSTANCE STUART
From Black Star



▲ THE WOMEN delight in bead ornamentation. The white, red, and blue beads are bound firmly around a ring of dry grass

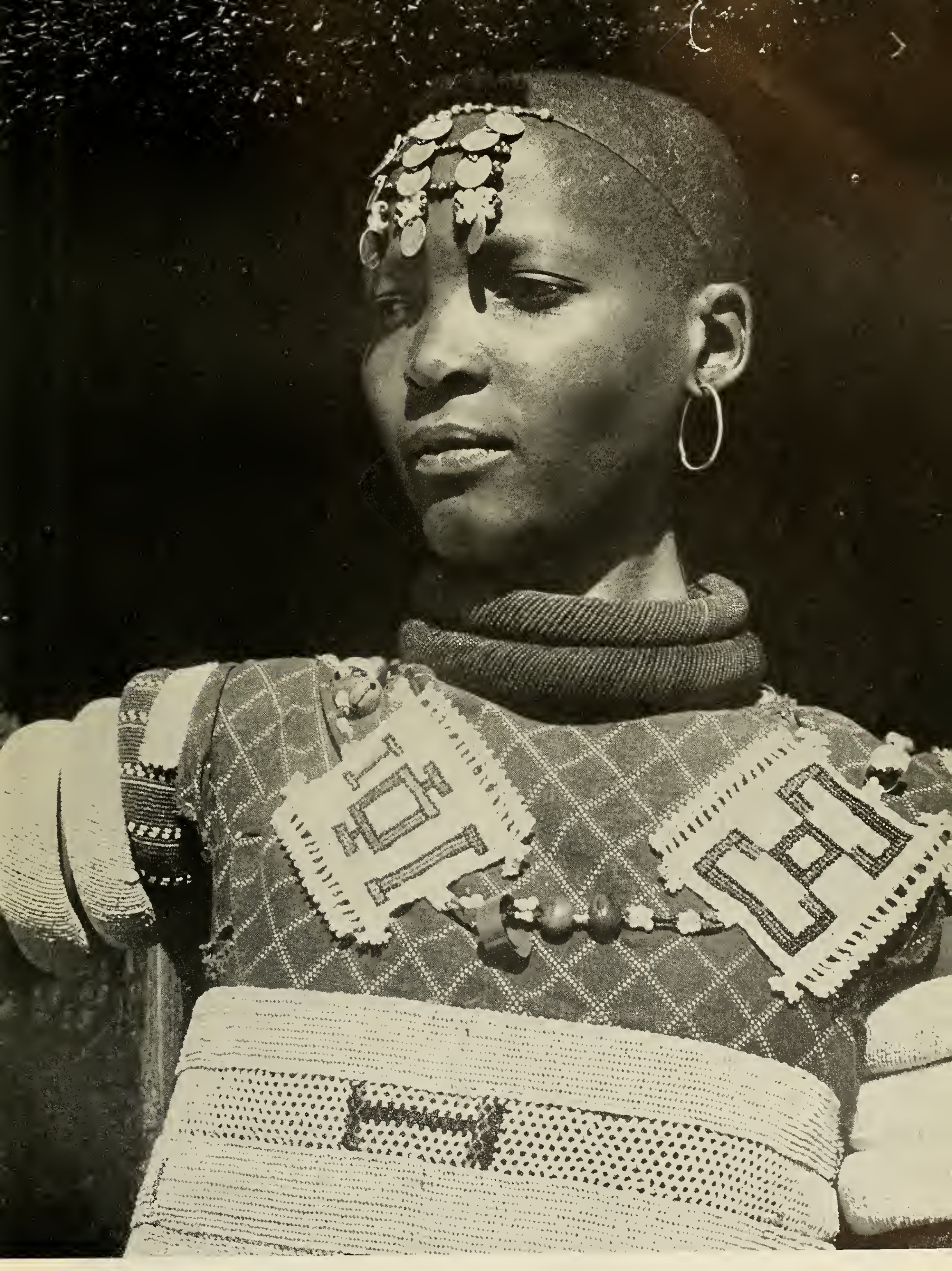
THE people illustrated in these pages live scattered about in the northern and eastern districts of the Transvaal, South Africa. They are divided into a number of separate tribes, each under its own chief, but they bear the collective name Ndebele and claim to have had a common origin. Their traditions relate that they once lived to the southeast, in what is now Natal, whence they migrated to their present homes many centuries ago. This suggests that they are ethnically connected with the Zulu (who still live in Natal), and certainly their language and customs, where still preserved, show that they have many close affinities with that famous warrior people.

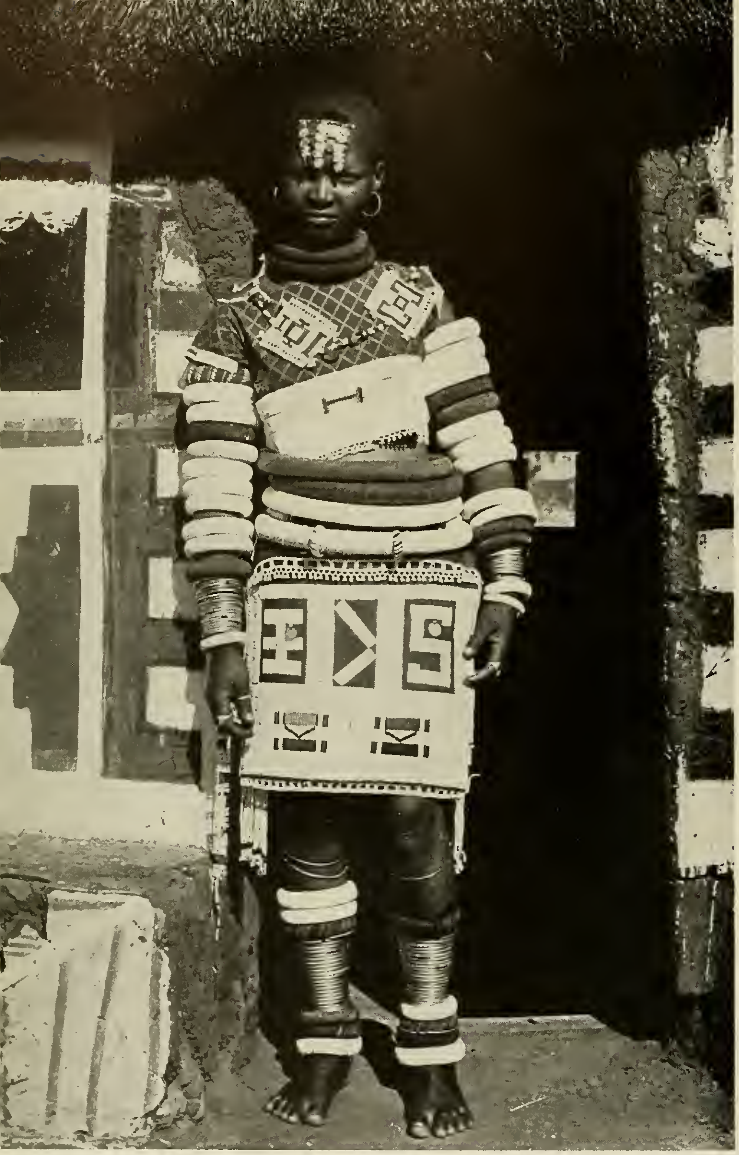
Nevertheless, most of the Transvaal Ndebele have virtually lost their identity. Living for centuries closely surrounded by peoples of Sotho stock, they gradually acquired the language and even the usages of their neighbors, and today there are in the country several tribes, such as the Seleka and Malete, whose traditions show that they are Ndebele but who in all other respects—physical, linguistic, and cultural—are indistinguishable from the Sotho.

This fact lends all the more interest to the groups photographed by Miss Stuart. Unlike the others, they have preserved to a remarkable degree their language and much of their traditional culture; and to find, within twenty miles of Pretoria (the Union of South Africa's administrative capital) people who still wear such distinctive costumes as here illustrated shows that the reputation they enjoy of being very conservative is well founded. Contact with white missionaries, farmers, and others has of course made itself felt in various ways. The men, for instance, all wear European clothing and go out in large numbers to work in towns or on the farms. But most of the women have retained the old national dress, consisting of skin petticoats and innumerable bangles and circlets of brass and beadwork, which are very much in evidence on festive occasions; and the customs connected with domestic life and magic also persist fairly strongly.

Like many other South African Bantu, the Ndebele live in small

▶ AMPLY ADORNED with the armlets and bangles that are traditional among her people, Khumbuza illustrates well the personality of the Ndebele. Her name means "Energetic Person"

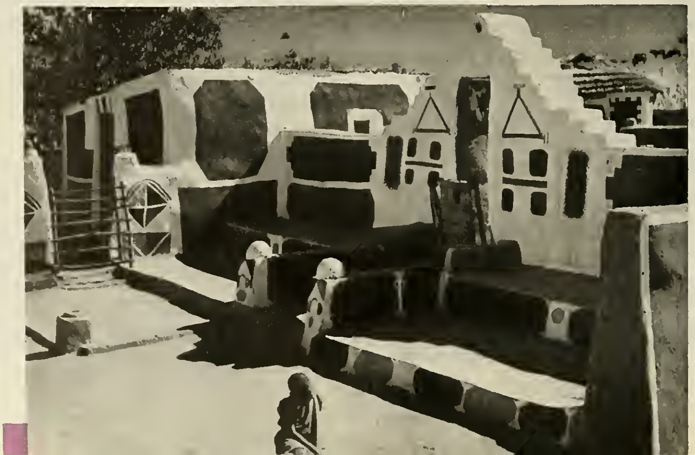




villages, each inhabited predominantly by the members of a single family group, consisting basically of a man and his married sons, with their respective wives and children. Their huts were formerly made of wattle, in beehive shape, but today rectangular dwellings of European type are commonly built, with stone foundations, earthen walls, and thatched roof. The mural decorations, so well illustrated in the photographs, are apparently also a borrowed feature, being characteristic of the Sotho peoples rather than of the Nguni (to which group the Ndebele belong by origin). But whatever the type of dwelling, the traditional ceremony of having it "doctored" by a magician is still faithfully observed. Before the foundations are laid, pegs smeared with medicinal ointment are buried at the corners and in the center of the site. This, it is held, will protect the inhabitants from sorcerers and other evilly disposed persons, whose power to work harm is thus neutralized as soon as they come within the boundaries marked out by the pegs.

The number of huts that a man builds depends upon the number of his wives, each of whom must have her own hut. Polygamy is the ideal, and the more wives a man has, the greater may be the esteem in which he is popularly held. In the choice of a bride, preference is given to one's maternal cross-cousin (mother's brother's daughter). This, too, is a feature borrowed from the Sotho, since all other Nguni peoples prohibit mar-

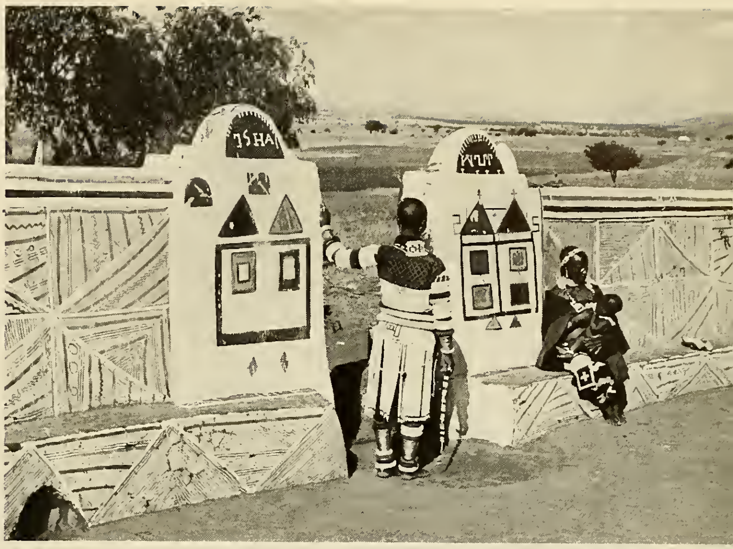
▲ IN FULL CEREMONIAL DRESS. The short bead skirt is a sign that this Ndebele belle is unmarried. Some of the bead rings are made on her and are not removable



➤ THIS GABLED ARCHWAY shows the Ndebele's love of decoration and sense of architectural design. Few other Bantu tribes show these talents riage between first cousins of any kind.

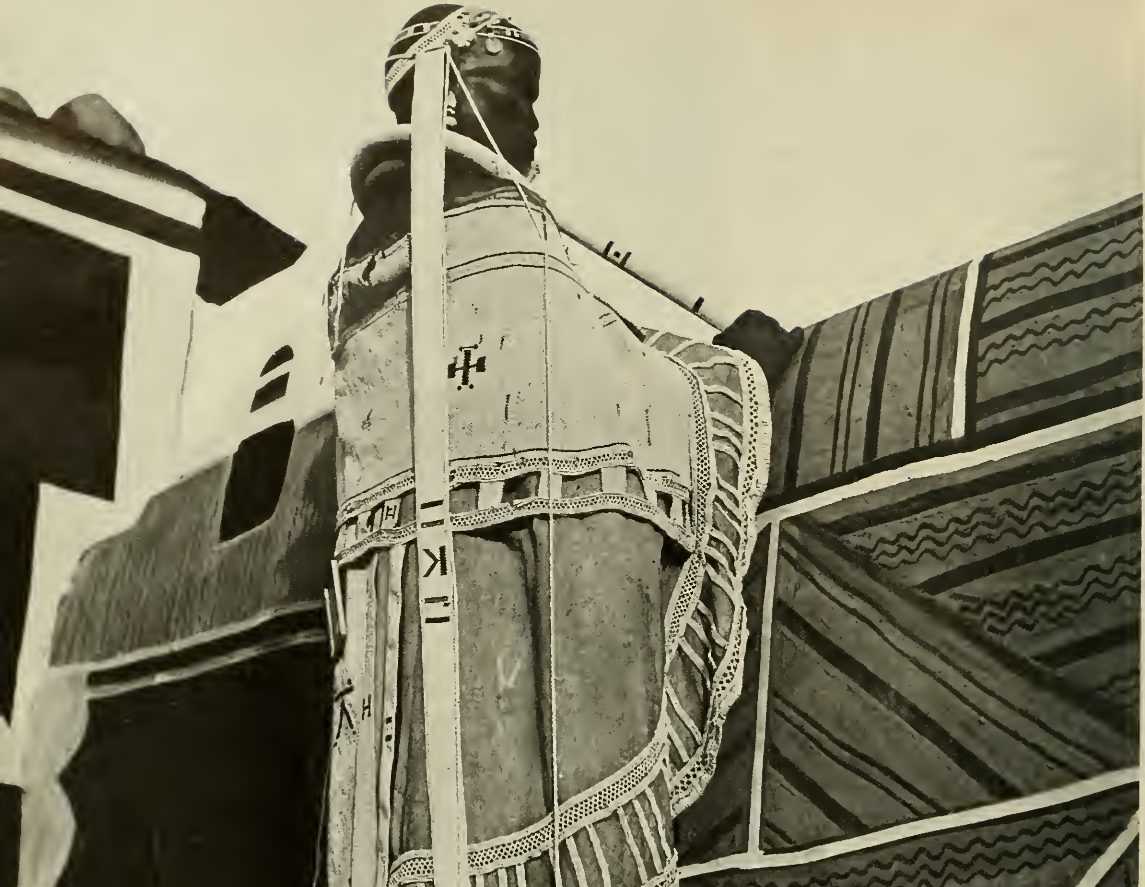
A young man usually chooses his own wife, but once the girl has agreed to marry him, the negotiations leading to formal betrothal must be conducted, according to stereotyped ritual, between their respective parents. To the parents of each wife that he marries, the man must give cattle, the usual number being six head.

Once married, a woman goes to live with her husband in the village of his father, where a new hut has been built to accommodate her. On the appointed day, she is accompanied from her own home by a sturdy girl friend, specially chosen to help her on this occasion. They sit down on the open veld, some distance from the village. The bridegroom, accompanied by a



▲ THE DESIGNS on each side of the gate are in paint. The others have been drawn on damp clay with a sharp stick. The latter are fairly common in the central and western Transvaal and even in Bechuanaland. The ones on the gateposts are more unusual and represent a distinctive modern development among these people

▼ THE YOUNGSTERS have a wonderful time when their parents are busy painting

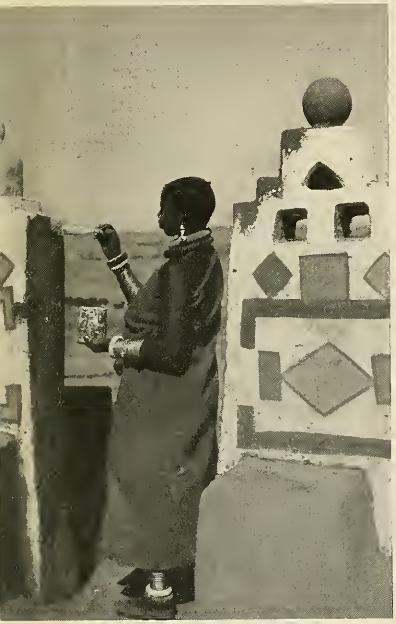


▲ THIS MAGNIFICENT CLOAK is worn by the bride on her wedding day but never again. Three months before her marriage, her father kills a sheep and fashions this skin cloak for his daughter. Then her friends set to work on the embroidery. The long bead strip hanging from her headdress takes the place of a wedding veil. She carries a short wedding stick band of youths and maidens, goes out to search for her. She and her friend, when found, are expected to offer resistance and must often, it is said, be carried forcibly into the hut. The door is firmly closed, so that they cannot escape. The bridegroom then begins to kindle a fire; the bride and her friend try to prevent this by kicking the fireplace to pieces, while the husband's companions try to restrain them. If he succeeds in lighting the fire, he begins to prepare a meal. This also the bride and her friend hinder as best they can; they slap and kick and do everything possible to prevent the cooking of the meal. When at last she gives up the struggle, she drinks a calabash of beer with her husband; and with that the ceremony of "dragging" her to his home is completed.

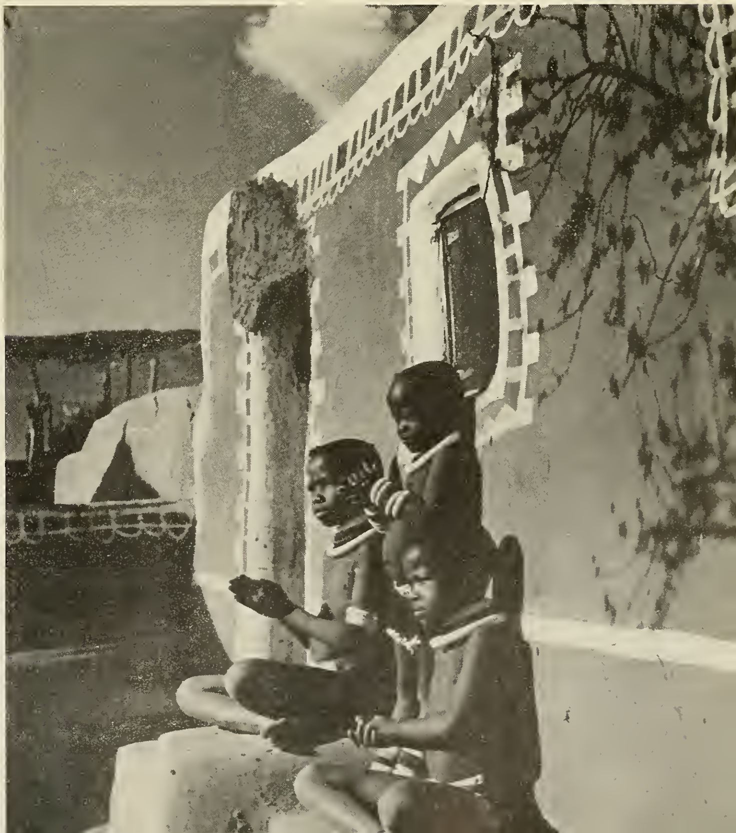
The young wife does not start her own housekeeping until after the birth of her first child; till then she works under the direction of her mother-in-law. Every married woman looks forward to bearing children, and if she remains childless, it is held that she either has been bewitched or has violated some important rule of conduct. In such cases, her husband may demand from her parents her younger sister or her brother's daughter as a substitute to "wipe away" the disgrace of her barrenness. So, too, if a young wife dies before having borne a child, her husband is entitled to a substitute, failing which he may claim the return of his cattle. On the other hand, if he himself dies while his wife is still relatively young, she is taken over by his younger brother or by some other close relative, who cohabits with her in order to raise seed to the deceased. All these usages indicate that the Ndebele would readily agree with the Anglican prayer book in holding that "marriage is ordained for the procreation of children."

Children, almost from the time they are able to walk, help their parents. The boys look after the lambs and kids and, as they grow older, are entrusted with herding, first with the calves and small stock and then with the large cattle. The girls help their mothers fetch water and wood, clean the home, cook the meals, and so forth; and as they approach puberty, they also take part in the cultivation of the fields.

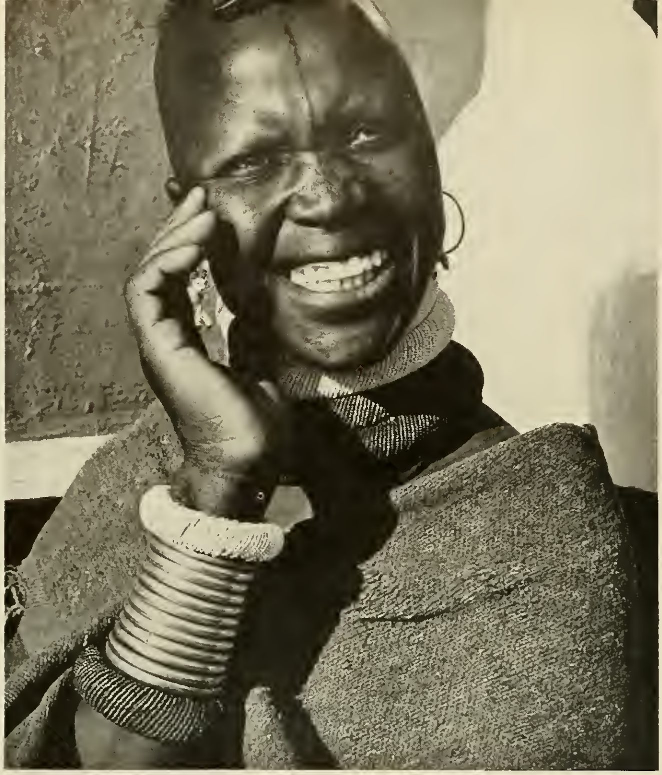
These are only a few of the customs that the Ndebele still observe despite the changes produced by contact with western civilization. Other usages have apparently become obsolete, such as the worship of ancestors, the ceremonial eating of the first fruits (at which the chief took inviolable precedence), the "doctoring" of the tribal army before and after battle, and the traditional system of tribal government. With their decay, much of



▲ Modern implements but ancient coloring material. Notice the clay at left, which she used in making her design. Her name is Nzangobe, meaning an unafraid and forward person. Painting time is usually early spring or in honor of some ceremonial affair



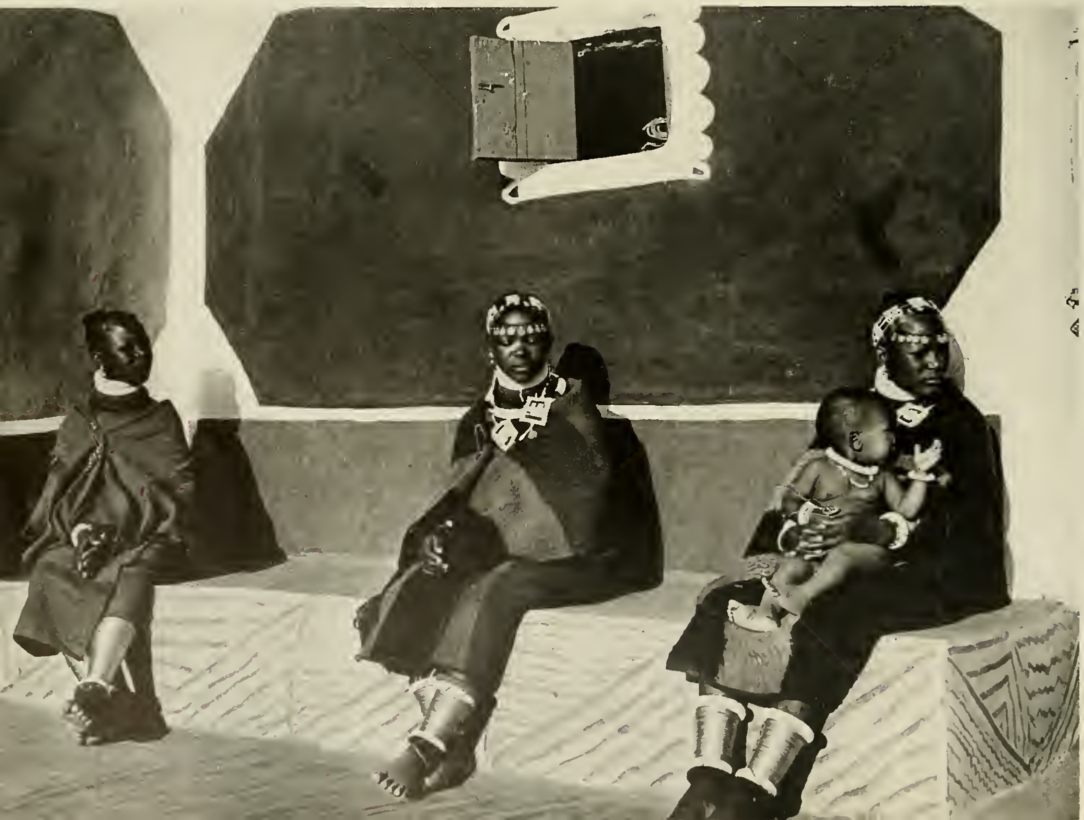
➤ These children are welcoming the spring, clapping their hands and singing

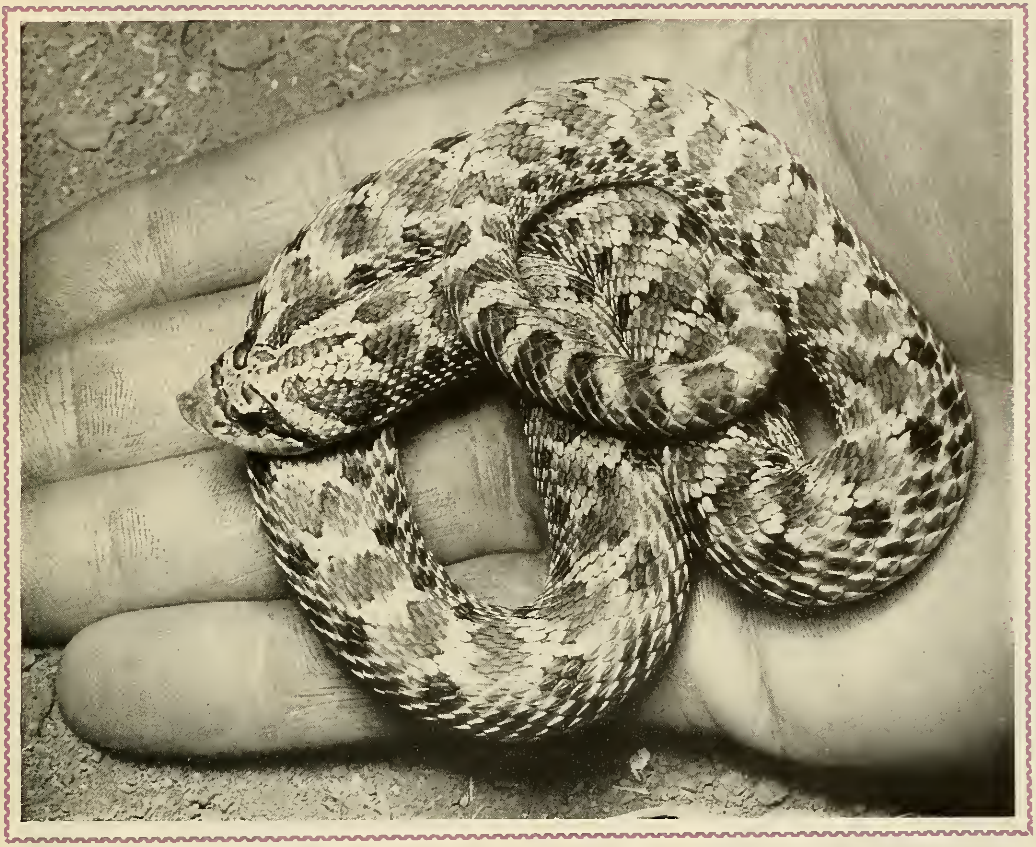


the glamor and color has departed from the life of the Ndebele. The modern farmhand or mine laborer, living under the rule of an alien government and exposed to all sorts of new influences, is a very different person from his ancestors. But the people still have enough of their old culture to form a picturesque section of the South African Bantu; and Dr. N. J. van Warmelo, our main authority, rightly described them in 1930 as "an unworked mine of ethnological information." That mine has by no means been fully explored; and the Transvaal Ndebele still rank among the least known inhabitants of the country.

◂ SHAVING THE HEAD is a regular fashion, but the decorative bow is a whim from Woolworth's Bazaar. Note the cheerful, smiling face and magnificent teeth

▾ ON SUNDAYS the women of the Ndebele dress in their best and visit each other





▲ THOUGH OFTEN MISTAKEN for a dangerous snake, the hognose is quite harmless

HOGNOSE SNAKE — Possum Player Extraordinary

Scientists doubt that when it "plays dead" it is consciously deceiving its enemy

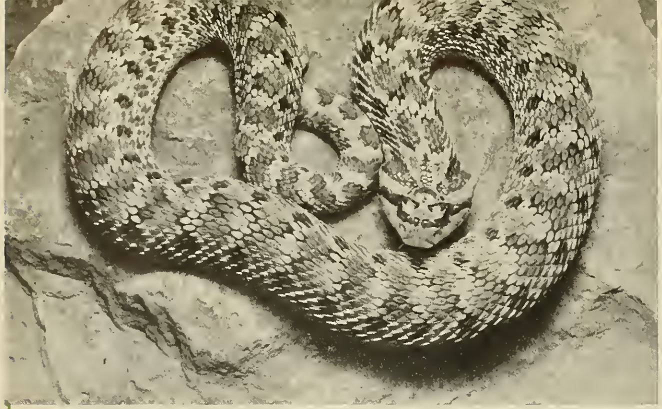
By GEORGE M. BRADT

All photographs by the author

WHEN a hognose snake plays possum, it outdoes even the famed marsupial for which this curious defensive behavior is named; it literally outpossums the opossum. Many animals feign death when their lives are threatened. Foxes, terns and rails, various lizards, spiders, and beetles, even measuring worms, wood lice, and water scorpions are known to resort to this strange strategem. But none can equal in interest and variety the bizarre death-feigning of the hognose snake.

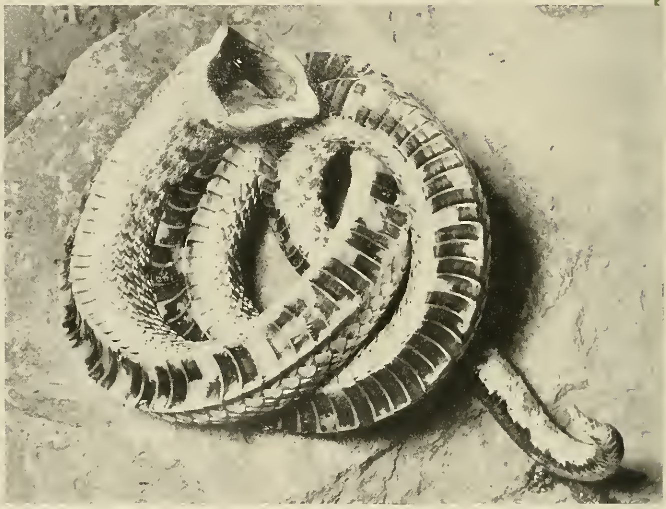
Most possum players are pacifists at heart and surrender without a fight when face to face with danger. They just "curl up and die." But not hognose! At the appearance of an enemy, this versatile reptile dilates its head and neck to form an arresting cobra-like "hood," flattens its stubby body to make it appear larger, inflates its single lung with air—then strikes and hisses in a manner guaranteed to startle anyone unfamiliar with its true nature. This formidable behavior has not only earned it a reputation for being aggressive and highly poisonous, as well as the sinister names "puff adder," "hissing viper," and "spread head," but has assured it a speedy and violent death whenever encountered by man. Actually this common American snake of the genus *Heterodon* is utterly harmless and can seldom be induced to bite. Its act is pure bluff!

If a suspicious adversary calls its bluff, however, hognose proceeds to get out of the game and cash in its chips in a most unusual way. Instead of trying to run away "to live to fight another day," hognose

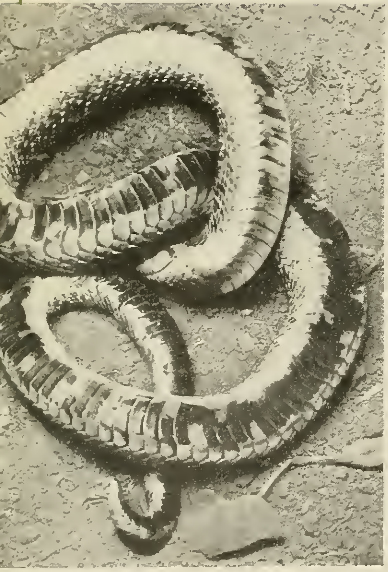


◀ Before simulating helplessness or death, the hognose snake flattens its head and body in this "bluffing" pose

▼ When this individual was first seen sunning itself in the middle of a paved highway, it lunged and hissed in the best hognose manner. After it quieted down, it was placed on a flat rock, where it demonstrated its death-feigning pose nicely for this photograph. In this position, it failed to bite when the author placed his little finger into its wide-open mouth. A few minutes later it righted itself and glided away



▼ After two previous performances, the snake was gently prodded with a stick to induce it to "die" a third time. It then rolled over onto its back and coyly tucked its head beneath its body, as if to say, "Go away, I want to be alone"

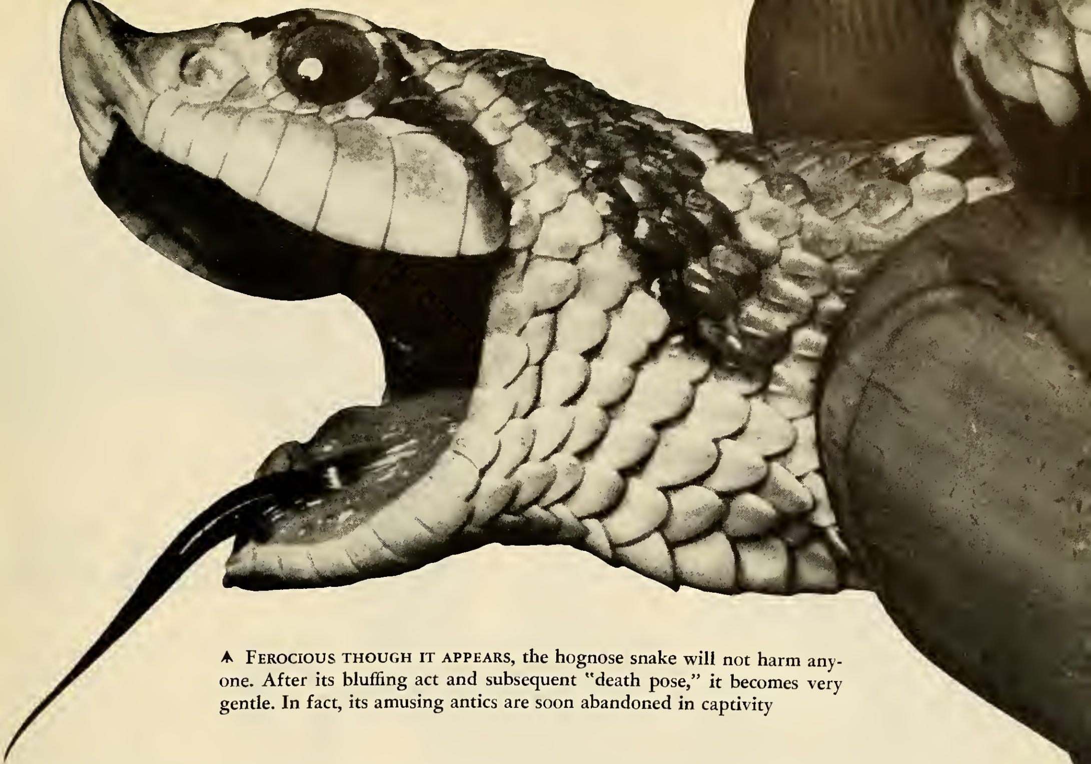


simply stops lunging and hissing, rolls over onto its back, gives a few convulsive wriggles, opens its great mouth, and "expires" before its assailant's astonished eyes. A "deader" snake cannot be imagined. So well, in fact, does this histrionic creature enact the role of the deceased that any number of indignities may be perpetrated upon its scaly person. Raymond Ditmars wrote of tying these snakes into knots, hanging them over rail fences, and carrying them about by the tail for long periods of time without their showing the slightest sign of life. A finicky captor, taken in by its victim's sudden "death," is apparently supposed to turn up its nose at such inedible carrion and depart, leaving the "remains" for the vultures. It is doubtless true that many a hognose snake owes its life to the success of this ruse.

Should it be left for dead, however, it makes a miraculous recovery and, after turning over onto its belly, quietly glides away. It waits for no applause, no curtain calls; its act has served its purpose. But let its enemy reappear and hognose eagerly performs an encore, "dying" a second time before its presumably gullible audience. It can be made to repeat this ludicrous performance time after time by merely placing it on its stomach, from which position it immediately throws itself onto its back to "die" again and again!

After witnessing the realistic death-feigning act of the hognose snake, it is difficult not to credit this amazing creature with great intelligence, cunning, and presence of mind. One is tempted to believe that its convincing bluff and subsequent demise are part of a deliberate plan to deceive its enemies. But, disillusioning as it may be, this is not the case.

Naturalists have for years been intrigued by the so-called death-feigning instinct in animals but have long suspected that there was more involved than met the eye. Darwin was impressed by the differences between the positions assumed by really dead insects and



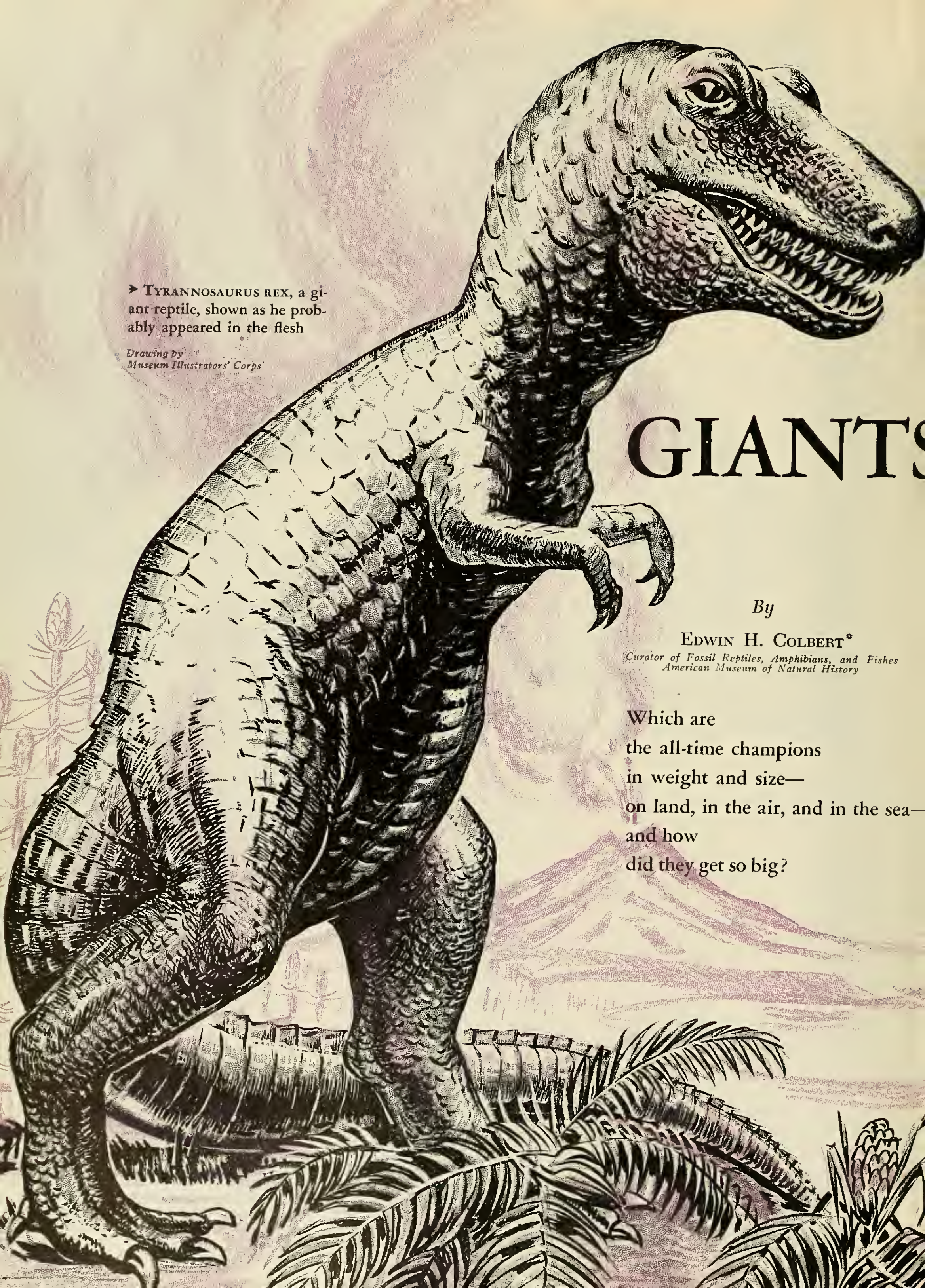
▲ **Ferocious though it appears, the hognose snake will not harm anyone. After its bluffing act and subsequent "death pose," it becomes very gentle. In fact, its amusing antics are soon abandoned in captivity**

those that were "only fooling," and Fabre successfully demonstrated the unpremeditated nature of possum playing among beetles. Thirty-odd years ago, in his *Studies Of Animal Behavior*, S. J. Holmes discussed the above experiments of Fabre and Darwin and added that in his opinion, "The expression 'feigning death' is a misleading one to the extent that it is apt to give rise to the idea that the animal consciously adopts this device with the intent to deceive." Nevertheless, Professor Holmes did consider it possible that in birds and mammals there was "a tolerably acute consciousness of the situation." W. H. Hudson, in *The Naturalist in La Plata*, has an entire chapter on death-feigning, and himself found it difficult to reconcile the apparent insensibility of the Argentine fox under the cruel beatings inflicted upon it by Hudson's gaucho companions with the fox's cautious and deliberate flight at the departure of its enemies. The question has always been: Does the fox, or opossum, or hognose snake *feign* or just *faint*? How much of their acting is conscious, how much unconscious?

The probable answer to this baffling problem is as surprising as the possum-playing performance itself. It can be found in the December, 1945, issue of NATURAL HISTORY, in which Dr. Frank A. Beach, now Professor of Psychology at Yale University, discusses the so-called hypnotic trance in animals. Dr. Beach considers it possible that the death-feigning phenomenon is a "variant of *tonic immobility*." This is the term used to designate the state induced in certain animals when they are suddenly turned upside down. The animals so treated "remain relatively motionless for varying periods of time" and "fail to show any response to many stimuli that ordinarily would elicit a definite reaction . . . It is suspected," he continues, "that this treatment causes the release into the circulatory system of specific glandular secretions, and that these hypothetical chemical agents paralyze certain higher nervous centers of the brain." Apparently the inverted position assumed by the hognose snake when frightened or molested results in the same paralyzing effect. Hognose simply passes out.

It has been inferred that, because the condition of tonic immobility usually persists in any given animal for a definite and relatively unvarying time, the creature comes to only after the paralyzing glandular secretion has worn off. However, one wonders whether this can hold in the case of the hognose snake, because if you try to turn your passed-out snake right side up, it almost invariably turns upside down again. Moreover, there is no reason why a snake that has "fainted" should necessarily turn upside down in the first place. So perhaps we have yet to discover the complete explanation.

But in any case, even if our hognose hero does not *act* his tragic pantomime of death but merely *reacts* it, certain it is that if there are any "Oscars" to be awarded in the world of animal acting, the vote of many naturalists will unhesitatingly go to the hognose snake, possum player extraordinary.



➤ TYRANNOSAURUS REX, a giant reptile, shown as he probably appeared in the flesh

Drawing by Museum Illustrators' Corps

GIANTS

By

EDWIN H. COLBERT*

Curator of Fossil Reptiles, Amphibians, and Fishes
American Museum of Natural History

Which are
the all-time champions
in weight and size—
on land, in the air, and in the sea—
and how
did they get so big?

f the Animal Kingdom

EVER since the dawn of history and probably for long ages before that, Man has been a creator of giants. As a result of the workings of his fertile mind, he has built up pictures in his imagination of huge beings roaming the earth, and at times these giants have seemed very real. Giants play a prominent part in legend and folklore, and we are all well acquainted with them from the days of our childhood.

Perhaps some of the tales of giants are not without a background of factual evidence. We know from various accounts that through the centuries Man has frequently (and usually accidentally) dug up or discovered the bones of large animals long since extinct. Before the birth of the scientific study of fossils, it was quite natural for credulous people (and in those days most people were credulous) to regard such large bones as the remains of giants. So the legends found support in things that were dug out of the earth. There must have been giants on the earth, for were not these the bones to prove their former existence?

Very likely the fossil bones of extinct elephants or perhaps of some of the large dinosaurs were the "proof" by which ancient and medieval Man confirmed his belief in giants. For instance, the Spanish conquistador, Captain Bernal Diaz del Castillo, a trusted and faithful officer in the little band of intrepid adventurers who, under Cortez, conquered Mexico, mentions confirmation of the existence of giants in his detailed and fascinating account of the conquest. His description, obviously based upon the bones of an extinct elephant or mammoth, is as follows:

"They [the Tlascalan chiefs] said that their ancestors had told them, that in former times the country was inhabited by men and women of great stature and wicked manners, whom their ancestors had at length extirpated; and in order that we might judge the bulk of these people, they brought us a bone which had belonged to one of them, so large, that when placed upright it was as high as a middling sized man; it was the bone between the knee and the hip; I stood by it, and it was of my height, though I am as tall as the generality of men. They brought also pieces of other bones of great size, but much consumed by time; but the one I have mentioned was entire; we were astonished at these remains, and thought that they certainly demonstrated the former existence of giants." †

Let us make a respectful bow to the legends and imaginary tales of the past and turn to the hard scientific evidence of the present day. From such evidence we know that there have been and still are giants on the earth but not giants of the fairy tale variety. The vanished giants that left their bones as visible proof of their former greatness were giant animals of various sorts, and many of them lived long before there were any men to see them. There are giants today, but these beasts are so familiar to us that for the most part we are not astonished at their great size. Some of these giants have lived and do live in the water—giant fishes and swimming reptiles and whales. Others have walked or do walk across the face of the land—giant dinosaurs and mammoths and elephants. As a result of scientific study, these giants are now well known to us, and we recognize them for what they were or are.

What makes a giant? What are

AMNH photo

▲ THESE TWO will never reach Tyrannosaurus' great height of 20 feet, but man's outstanding achievement is in the realm of intellect. No other creature has approached his capacity for curiosity and independent thought

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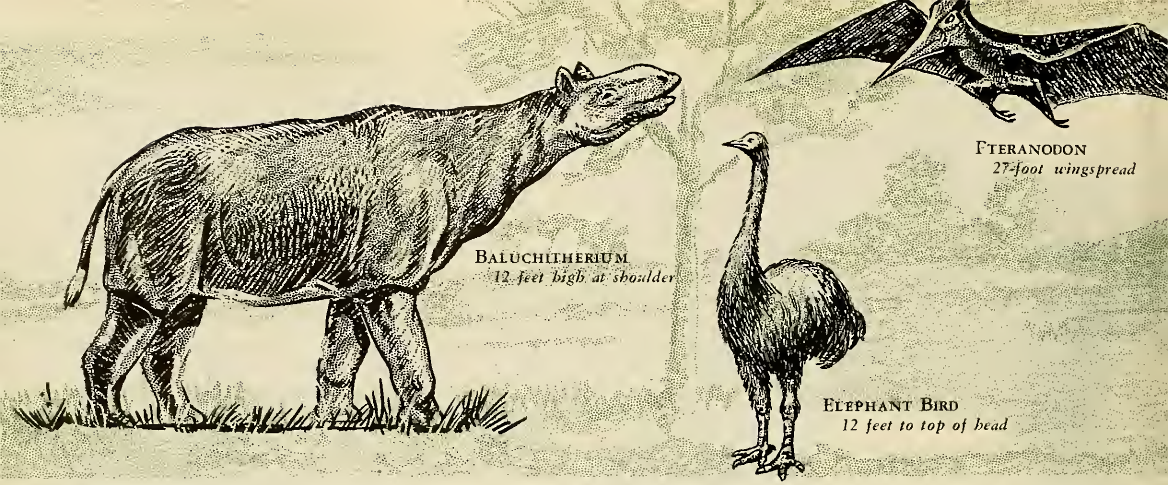
†Bernal Diaz del Castillo—*The True History of the Conquest of Mexico.* Translated by Maurice Keatinge. New York, 1927, Robert M. McBride and Co., p. 143.

*EDWIN H. COLBERT has been studying fossils and looking for them for something more than 20 years. During that time he has described fossil mammals and reptiles from North and South America and from India, China, Mongolia, and Africa. At present, he is especially interested in the reptiles that inhabited the earth at the beginning of the Age of Dinosaurs. Two years ago, part of a claw of a small dinosaur, a fragment no larger than one's fingertip, led him and his associates to a deposit in New Mexico from which they obtained a large and remarkable series of fossil skeletons of primitive dinosaurs. (See "The Little Dinosaurs of Ghost Ranch," NATURAL HISTORY, November, 1947.) Dr. Colbert has written a number of articles for NATURAL HISTORY, and he is the author of *The Dinosaur Book.* He was graduated from the University of Nebraska and completed studies for his higher degrees at Columbia University. He is now a Curator at the American Museum of Natural History and Professor of Vertebrate Paleontology at Columbia University.—ED.



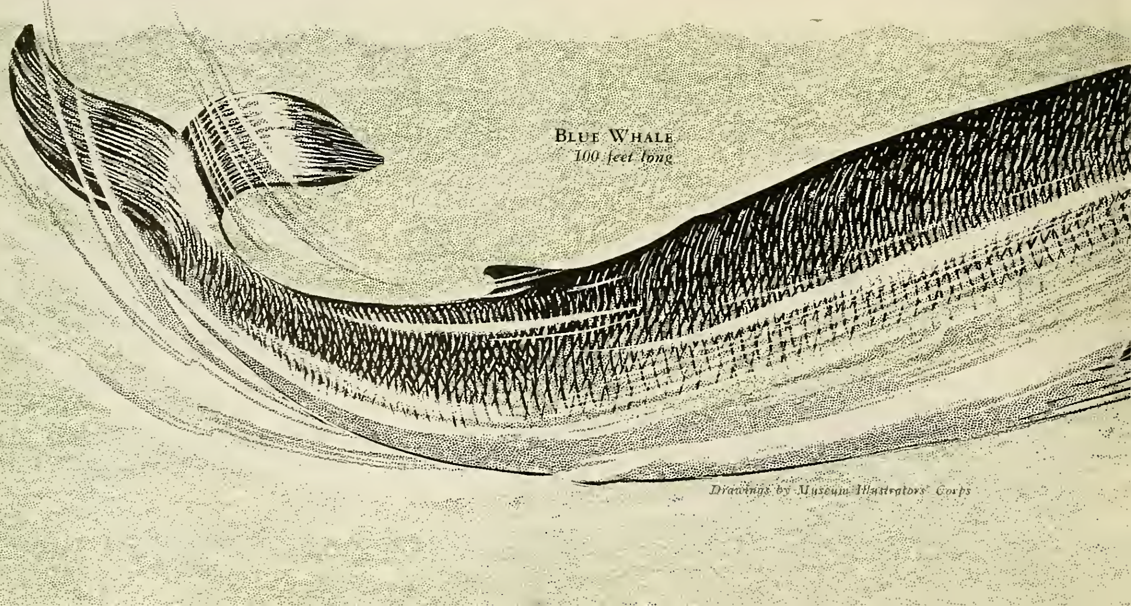
the advantages and the disadvantages of being a giant? If some animals could achieve giantism, why did Man never become a giant?

The three general habitats for giants, as for all other life are, of course, the water, the earth, and the air. The largest giants have been and are water-living animals. Throughout the long history of the earth, giants have been common on the land; but the largest land giants have never been as large as the aquatic ones. On the other hand, giants in the air are comparatively rare. There seems to be no limit to the ultimate size of man-made flying machines, but for flying animals the limits are very rigid. Even the largest of the flying animals are hardly giants at all when compared with the giants of the earth and the water.

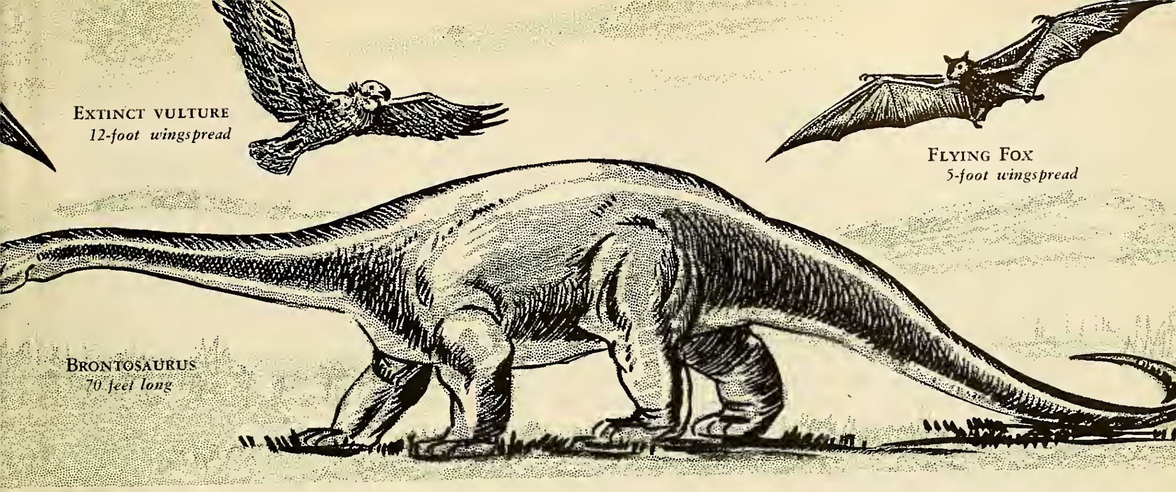
One of the greatest disadvantages of being a giant is the ever-present problem of gravity. The bigger an animal is, the stronger it has to be to support its weight against the pull of gravity. Consequently, there are definite and absolute limitations to the size of animals, depending upon their anatomical structure and their habitats. Bone and ligament and muscle all have definite physical properties. They have definite tensile and compressive strengths, beyond which they are torn apart or shattered. It is obvious, therefore, that animals cannot grow to a size beyond which their bones, ligaments, and muscles are able to support them.

As an animal grows in length, it grows much more rapidly in mass. Generally speaking, if one animal is twice as long as another, it is about eight times as heavy. In other words, the increase in mass is the cube of the increase in length. For instance, if a box one foot wide,

On the land, in the air, and in the sea there have been giants, but those in the water have attained the greatest size, because their medium is most favorable to their growth



Drawings by Museum Illustrators' Corps



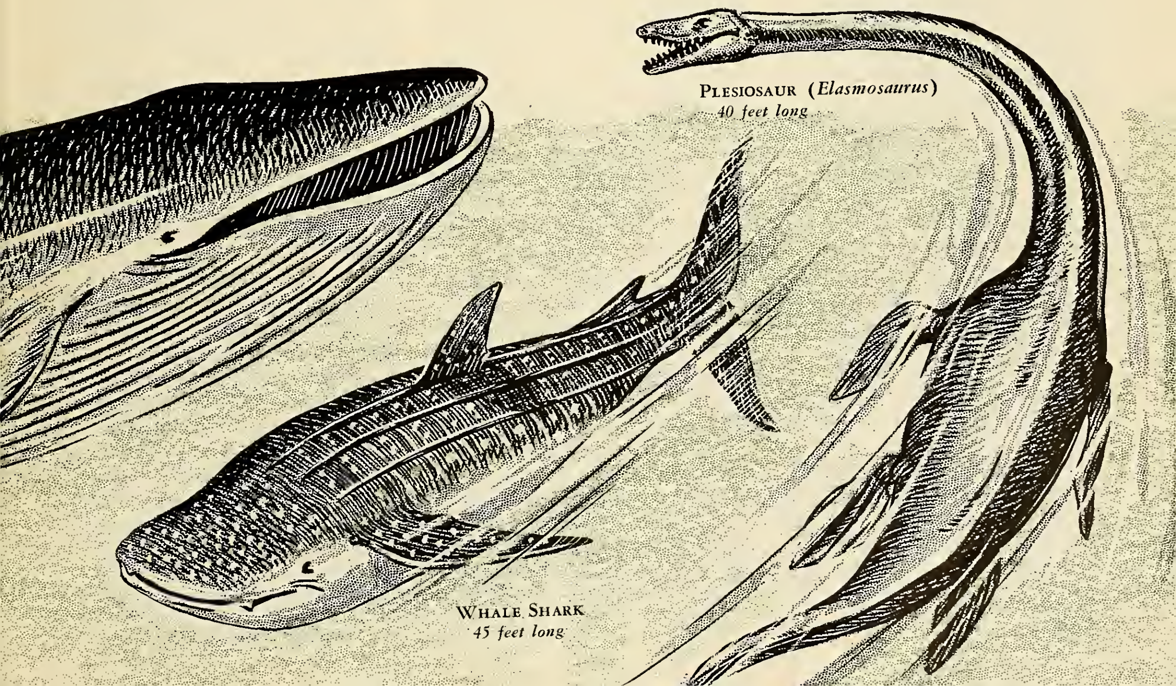
one foot high, and two feet long is increased so that its dimensions in each direction are double, it will hold not twice the weight of material that it originally held but eight times as much. The increase in size in animals is not as simple as this, but the principle is the same.

Of course, bones and ligaments and muscles increase in bulk as the animal increases in size, but their strength is not exactly proportionate to their bulk. Rather, the strength of a bone is more nearly proportionate to its cross section. Just as the mass of an animal increases much more rapidly than its length, so it increases more rapidly than the strength of the supporting members. These are some of the basic facts that determine the limits of size in animals.

Now, an animal that lives in the water is not a victim of gravity as is the land-living animal. It is buoyed up by the water in which it lives, which opens to the aquatic animal a path to greater giantism.

The land-living animal, on the other hand, is engaged in a constant if unconscious fight against the downward pull of gravity. It is not supported by the medium in which it lives, but rather it must provide its own support. Consequently, although the land-living animal can attain a considerable size, it can never grow as large as the water-living animal.

With flying animals, the limits to size are very restricted. When in the air, the flying animal must pit the absolute strength of its muscles against its weight. While its weight increases in proportion to the cube



of its length, its muscular strength is more nearly equal to the square of its size. Therefore, there is not enough muscle power available to carry a large, heavy animal through the air.

Other factors enter into this problem of giantism, factors of physiology, temperature controls, and food supply. They point up not only the limitations and disadvantages of giantism but the advantages as well—for there are certain advantages in being a giant. But to keep from getting too deeply involved in a complex problem, let us limit this consideration to that of weight alone. In view of the problems of weight, what were and are the giants in the animal world? How do they appear in the record of life on the earth, and what have been their relationships to the animal world around them?

It is evident that giants cannot be defined easily, whether they live or have lived in the water, on the land, or in the air. There have been giants among the backboned animals, or vertebrates, and giants among the animals that do not have backbones, the invertebrates. In fact, that symbol of spinelessness, the jellyfish, has entered the contest and produced the champion in linear dimensions—a jellyfish with tentacles longer than any whale. Different criteria for the definition of giants must of necessity be applied, according to the relationships of the animals under consideration or the habitats in which they live.

Since this discussion must have some boundaries, the giants herein considered will be those with backbones. They will be the giant vertebrates. Among the vertebrates the giants will be defined, quite arbitrarily, as those animals having at least one body dimension measuring ten feet or more and, except for flying animals, a weight of at least several hundred pounds.

The earliest giants among the vertebrates or backboned animals were giants of the sea. They appeared at an early stage in vertebrate evolution, some 350 million years ago in the Devonian period of earth history. They were huge, fishlike creatures that swam in the waters of estuaries that indented the coast lines of those distant days. These giant arthrodires had tremendous heads, with widely gaping jaws armed not with teeth but with bladelike, bony plates that functioned in a manner similar to teeth. From the great head the body tapered back to a rather sharklike tail, while just behind the head was a pair of rather small fins, one on each side. The largest of the arthrodire giants attained a length of 30 feet, and they probably reached a weight of 10 tons or more. These arthrodires did very well in their day and evidently were the rulers of the waters in which they lived.

At the end of Devonian times the arthrodires became extinct, and the "true" fishes, already developing rapidly during the Devonian period, became the dominant vertebrates of the waters. Since then, during the long history of the fishes, giants have frequently appeared, and some of them are still with us. Millions of years ago there were trends toward giantism among the sharks, as indicated by the mute testimony of fossil shark teeth of great size. Evidently the ancient sharks, of which these teeth are the sole remains, must have been 40 or 50 feet in length—so large as to make most modern sharks look puny by comparison. But it should not be thought that all of the giant sharks existed in past times, because there are still giants, such as the basking shark, and more particularly the whale shark, one of the largest of all fishes, past or present. A big whale shark will measure 45 feet in length and have a weight of more than 13 tons.

There have been giants among the bony fish, too, but none of these measure up to the shark giants. A fish known as *Portheus*, which during the age of dinosaurs swam in the shallow, mediterranean seas covering what is now the state of Kansas, was a giant with a length of some fifteen feet and a probable weight of more than a ton. It was a big fish, but giants of somewhat lesser size are still to be found among the bony fishes of today, fishes such as the tuna and the swordfish.

Among the air-breathing vertebrates, any trends toward giantism soon ran into serious and numerous complications. The ever-present problem of gravity, together with attendant problems of physiology, food supply, and the like have made the way for the land giant a difficult one indeed. It is interesting, therefore, to see that among the air-breathing vertebrates giantism reaches its extremes in those animals that returned to the water to live.

For instance, during the age of dinosaurs three groups of reptiles became adapted to a completely aquatic mode of life. These were the ichthyosaurs, the plesiosaurs and their relatives, and the mosasaurs. The ichthyosaurs became secondarily very fishlike – streamlined animals with a propelling tail and with the limbs transformed into balancing fins or paddles. Some of these ichthyosaurs became rather large, but none of them were real giants, the largest being of a size comparable to some of the modern porpoises. The plesiosaurs and the mosasaurs, however, did reach the proportions of giants. The plesiosaurs were long-necked, short-bodied reptiles that rowed themselves along the surface by means of oarlike paddles, and some of these reptiles, especially those living in the Cretaceous period, were very large. The mosasaurs, which were nothing more than seagoing lizards, evolved into veritable monsters, reaching a length of 30 feet or more.

But no other water-living animals have ever equaled or even approached the huge size of some of our modern whales. These are the real giants of all time. Whales 60 feet in length, with a weight of about 60 tons, are not uncommon, while some species and genera such as the great Blue Whale reach almost unbelievable sizes. Blue Whales have been recorded with a length of almost 100 feet and a weight up to 150 tons.

The bodily transformations that

have taken place during the evolution of the whales into giants from their ultimate land-living ancestors have indeed been profound. These air-breathing mammals have become thoroughly aquatic, and so large are they that the bones, muscles, and ligaments are no longer able to support the weight of the body. In the water this is no problem, but when whales become stranded in water too shallow to float them, they soon die of suffocation. The weight of the body crushes the air out of their lungs.

Other giants have evolved among the mammals that returned to the sea, giants such as the sea elephants and the sea cows. But these are giants of a fairly moderate sort, and the whales remain the supreme example of giantism in the entire evolutionary picture.

Dinosaurs have already been mentioned, and these are known to almost everybody as the giants of the past. Here we see land animals solving the problems of being giants. Here we see what happens when the trend toward giantism runs full force into the law of gravity. The law is inexorable, and the evolving giants must adapt themselves to the law.

The largest dinosaurs were the great sauropods, the brontosaurs, measuring from 60 to 80 feet and probably weighing 30 to 50 tons in life. It is very likely that these figures represent the upper limits attainable for land-living animals—the limits beyond which bone, ligament, and muscle are of insufficient strength to support the great weight of the body. And in these huge dinosaurs we can see the adaptations that took place to make structurally possible these largest of land animals.

Thus, in the great dinosaurs the legs were enormously heavy and straight, and the bones were very strong and dense. The legs formed veritable posts or pillars for the support of the animal. The backbone, on the other hand, while strong, was lightly constructed. There were complex articulations between the individual bones of the spinal column to make them interlock more firmly, but the vertebrae themselves were hollowed-out structures in which bone was present only where needed and absent where not essential. Great size was therefore attained without the addition of undue weight in the vertebral column. The sauropod dinosaur skeleton can be thought of as a strong truss supported on heavy abutments.

The dinosaurs were not the only giants among land-living reptiles. Even before the dinosaurs there were giant reptiles, especially certain crocodile-like reptiles known as phytosaurs, living 165 to 205 million years ago in the Triassic period. Yet compared with the larger dinosaurs, the phytosaurs were beasts of modest proportions, and the problems of giantism were not so serious for them as for the huge dinosaurs. There were the crocodiles, too—giants that still survive into our modern world. Here again, even the largest crocodiles have been spared the most difficult problems of being a giant on land.

After the dinosaurs became extinct, some 60 to 70 million years ago, the mammals became dominant on the earth, and trends toward giantism were repeated. Among the land-living mammals, certain groups evolved into giants, notably the great titanotheres of the Oligocene period (28 to 39 million years ago), the rhinoceroses, the hippopotamuses, and the elephants and their relatives. Of these various mammals the elephants and their relatives have throughout their history been the foremost of the land-living giants. They began their evolutionary history with an early trend toward great size, and this trend developed rapidly to produce long-nosed, tusked animals that ranged far and wide over the earth during much of the Age of Mammals. In evolving as giants, the elephants followed certain lines of structural development more or less similar to those followed much earlier by the giant dinosaurs. For instance, the elephants developed straight, heavy, postlike legs to serve as pillars for support of the body. But whereas the largest dinosaurs attained probable weights of 40 or 50 tons, the largest elephants, past or present, have probably never exceeded 8 or 10 tons. Consequently, adaptations to giantism in these mammals have never been as profound as in the dinosaurs.

In general, the titanotheres, rhinoceroses, hippopotamuses, and other giant mammals have been reasonably modest rivals of the elephants, but there is one exception. This was a giant rhinoceros that lived in Asia during the Miocene period, some 20 million years ago. It is known as *Baluchitherium*, because it was first discovered in Baluchistan. Baluchitherium was truly a monster mammal, standing eighteen feet in height at the shoulders. It dwarfs the largest of the elephants, and very probably, like the huge sauropod dinosaurs among the reptiles, it represents about the maximum size to which a land-living mammal can develop.

During the age of dinosaurs the first giants of the air appeared. These were flying reptiles known as pteranodonts, and some of these became quite large, with wingspreads of 18 or 20 feet. Yet although these winged dragons of the air were impressively large, they were not very heavy, and the body was hardly larger than the body of a good-sized turkey. They were mostly wing and lightly constructed. The bones were hollow, to make them light, and there were large attachments for flight muscles. The pteranodonts were giants only in dimensions, not in mass.

The birds, too, have evolved their giants. The "giants" among the flying birds are the vultures, condors and eagles, the cranes and other wading birds, swans, and certain fowls such as the turkeys. Small giants, these. The real giants among the birds have been those that lost the ability to fly and became creatures of the ground. Various giant ground birds are found in the fossil record, and some of them persist to the present day—the ostriches, the emus, and the cassawaries. In these giant birds, as in so many other giants, we see the adaptations

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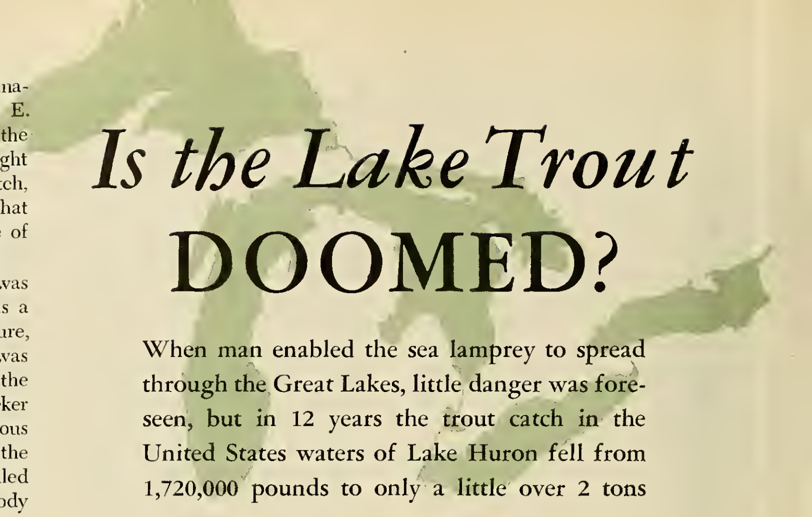


Is the Lake Trout DOOMED?

When man enabled the sea lamprey to spread through the Great Lakes, little danger was foreseen, but in 12 years the trout catch in the United States waters of Lake Huron fell from 1,720,000 pounds to only a little over 2 tons

By Ben East

IN November of 1921 a Canadian fisherman named A. E. Crewe, lifting pound nets off the port of Merlin, Ontario, brought to the top a strange double catch, two fish locked together in what would soon have been, for one of the pair, an embrace of death.

One half of the strange team was a big lake trout. The other was a repulsive looking, eel-like creature, close to two feet long, that was firmly attached to the side of the trout by means of a strong sucker mouth, and it kept its tenacious grip even when taken from the water. When it was forcibly pulled away, it left an eroded, bloody scar patch.

The "eel" looked like nothing Crewe had ever seen before. He took it to Canadian scientists for identification and was told that he had established a scientific record. It was not a record of good omen, however. What the fisherman had captured was the first marine lamprey ever taken in Lake Erie or anywhere else in the waters of the Great Lakes above Niagara.

It was an event of much greater significance than anyone suspected at the time. That first lamprey was a sort of advance scout, the forerunner of an invasion of these giant bloodsuckers into the upper Great Lakes, and likewise a forerunner of almost unbelievable disaster for the lake trout, whitefish, and other food fishes of those waters. As will be seen later, it was a dynamic illustration of how a small act on the part of man can create a conservation problem of tremendous proportions.

It is no longer novel, in Lake Huron, Lake Michigan, or even Lake Superior, for commercial fishermen to bring up in their nets fishes bearing lamprey scars or fishes with live lampreys attached. Lake trout, whitefish, herring, chubs, pickerel, suckers, carp, perch, and catfish, marked with one or more big eroded patches on throat, side, or back, are an everyday catch in the Great Lakes now.

Fishermen in Lake Huron have reported in recent years that as many as 90 out of each 100 trout caught show lamprey scars. In Lake Michigan from 50 to 70 per cent of the trout catch is marked at the present time. For the most part it is the larger fish that display the scars, because the lamprey is more inclined to attack the larger ones, and also the smaller ones are less able to survive the attack. In Lake Michigan, 80 per cent of the trout catch over 2 feet long is scarred, but a marked trout under 17 inches is a rarity.

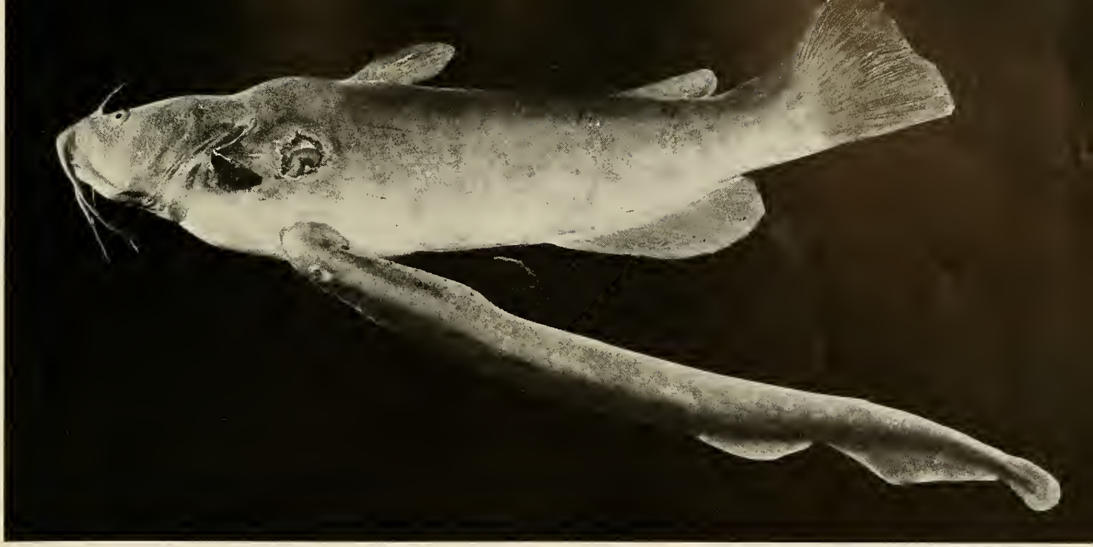
Many fish carry two or three scars. As many as nine have been recorded, each as big as a silver dollar or bigger. The scar may be healed over or it may be fresh and raw, still oozing blood. It may be shallow, penetrating only through scales and skin, but more often it goes all the way through the body wall into the belly, leaving a dreadful gaping wound. And for each victim that survives, probably hundreds, perhaps thousands, die unrecorded in the depths of the lake from the terrible blood-letting of the sea lamprey!

When the November gales stirred Lake Michigan last autumn, fishermen lifted nets that sagged with dead and decaying trout. That carrion catch, rolled into the twine by the storm-disturbed waters far down on the lake bottom, was indisputable proof of the toll taken by the lampreys. To load the nets in such a fashion, experts say, there must be areas where the floor of Lake Michigan is literally paved with decomposing trout that have died from lamprey attack!

The results of the lamprey invasion show, with dramatic and tragic clarity, in the record of the trout catch for Lake Huron and Lake Michigan.

Around 1936, the lampreys became firmly established and plentiful in Lake Huron, the first of the Great Lakes to feel serious effects from them. At that time the United States waters of the lake were producing an annual catch of 1,720,000 pounds of trout, the average figure for the previous 40 years. From 1936 on, the take dropped at a steady and alarming rate year after year, until it reached the incredibly low total of less than 5000 pounds in 1948.

It is hard to believe that the American waters of Lake Huron, once one of the foremost lake trout grounds in the world, produced only a little more than two tons of these fish last year, but such is the case. Trout are virtually nonexistent on those grounds today, and the situation on the Canadian side of the lake is only a very little better. For 30 years prior to 1940, the Canadian waters of Huron yielded an average annual take of close to 4,000,000 pounds of trout. Then the lampreys began their work, and the catch hit the skids. Each



AMNH photo

▲ **The sea lamprey** attaches itself by means of its rasping sucker, as shown in this model of a catfish in the American Museum. Millions of valuable food fishes are killed each year by this marauder

Mich. Department of Conservation photo by W. E. Hastings

▲ **An officer** of the Michigan Department of Conservation dipping a netful of sea lampreys from the spawning beds. Each female lays an average of 62,500 eggs!

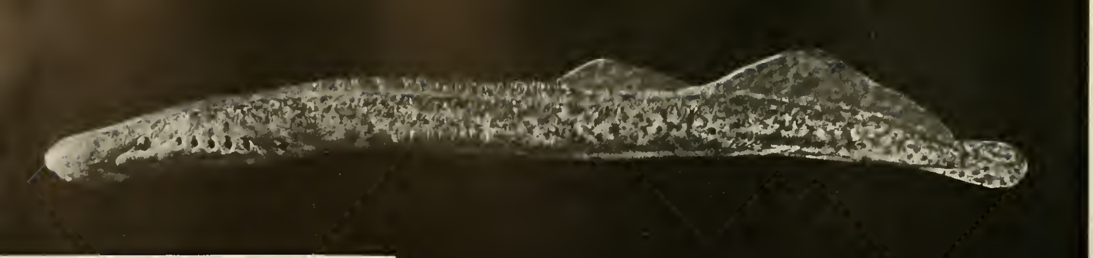
year since has set a new low record, and the catch now is down to less than 400,000 pounds annually, one-tenth of what it was in 1940.

The lampreys moved into Lake Michigan more recently. The first record for that lake was in 1934, and only in the last five years have they reached numbers sufficient to affect the trout catch. But they are reducing it now at a rate that threatens to wipe it out in a few more years. For the 5-year period from 1939 to 1944, Lake Michigan's trout production averaged around 6,500,000 pounds annually. Since that time it has fallen at the rate of about 1,500,000 pounds a year, until last year it totaled only a little more than 1,000,000 pounds.

The lampreys have only recently reached Lake Superior, but no one who is familiar with the situation has any doubt as to what is going to happen there from now on.

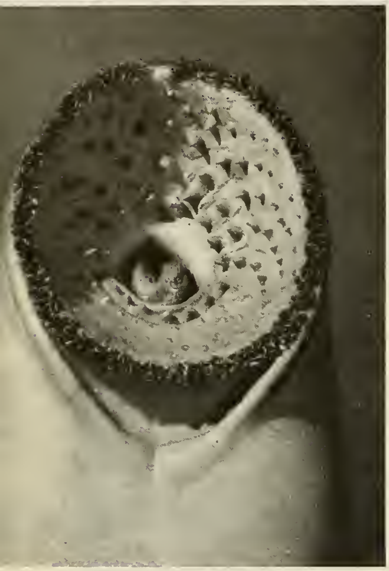
It seems inevitable that the lake trout, one of America's most popular food fishes, must disappear entirely from our tables within another decade or two unless a way is found to cope with the lamprey problem.

"The sea lamprey," declares John Van Oosten, chief of Great Lakes fishery investigations for the United States Fish and Wildlife Service, "is giving lake trout fishing in the



AMNH photos

▲ THE SEA LAMPREY, sometimes 30 inches long, "swims like a snake and looks like a length of garden hose." Its bluish-gray is mottled with yellowish or brownish blotches during spawning



◀ WITH this efficient circular rasp, the sea lamprey attaches itself to its victim and feeds on it. The scar it makes is about the size of a silver dollar

Great Lakes its final blow toward extinction!"

Nor is that all. What will happen after the lake trout has disappeared, as it now seems certain to do in a few more years, no one can predict. But those who have studied the lamprey do not believe the giant bloodsuckers will lie quiet on the lake bottom and die of starvation, so long as there are other fishes in the water to be attacked!

Up to now they have displayed a marked preference for lake trout, perhaps because the small scales of the trout render it particularly vulnerable. But the lamprey does not hesitate to attack other fishes, even under present conditions. Its preference after trout, in the Great Lakes, is for whitefish, suckers, pickerel, and carp, in that order. It seems a foregone conclusion that once the trout are gone the lamprey will turn its attention to other species, wiping them out one after another, unless some method is found in the meantime of eliminating the lamprey itself.

Small wonder authorities in both Canada and the United States declare that unless the lamprey menace is brought under control the fishing industry of the Great Lakes, worth $12,000,000 a year to the fishermen themselves, is facing almost certain ruin. The ghost-town specter hangs over many a thriving fishing port along the coast of Ontario, Minnesota, Wisconsin, and Michigan today and as yet is largely unrecognized.

For the sea lampreys give every evidence that they are going to be a tough pest to control or eradicate. In two years of persistent effort, scientists and fish culturists have made little headway toward finding effective ways of waging war on them. It is generally conceded now that they have gained such a foothold in the Great Lakes that there is no possibility they can ever be eliminated. The best that can be hoped for, apparently, is that natural checks will ultimately halt the rising curve of the lamprey population, until continued research can turn up control measures to hold down the lamprey throng and reduce to a minimum the amount of damage, as the damage done by many insect pests is now kept in check. Even that goal, however, promises to be extremely difficult to attain in the case of the sea lamprey.

The lamprey is a primitive fish and was originally found only in salt water, spawning in streams along the coasts of both North America and Europe. Many years ago it moved in from the sea to establish itself in a smaller or dwarf form in Lake Ontario and the Finger Lakes of New York. But until 1921, the thundering barrier of Niagara barred the lamprey host from the upper Great Lakes. It was man himself who unwittingly helped the creatures around that barrier.

The lampreys first gained access to Lake Erie by way of the Welland Canal, although no one knows whether they came under their own power or hitchhiked in by attaching themselves to the bottoms of ships, a common habit of theirs. Experts believe new invasions may still be making their way into Lake Erie annually, coming by that same route, to reinforce and swell the ranks of the teeming host already firmly established as far away as western Lake Superior. But curiously enough, although they were first discovered in Erie and must have passed through that lake to reach their present centers of abundance farther from the sea, they have never established themselves there in sufficient numbers to do major damage to the commercial fishery. The reason may lie in the fact that Erie has relatively few areas of deep water, which lampreys appear to require, or that it does not offer them tributaries suitable for spawning. Whatever the reason, the lamprey population in Lake Erie has remained below the danger point as far as the food fishes of the lake are concerned.

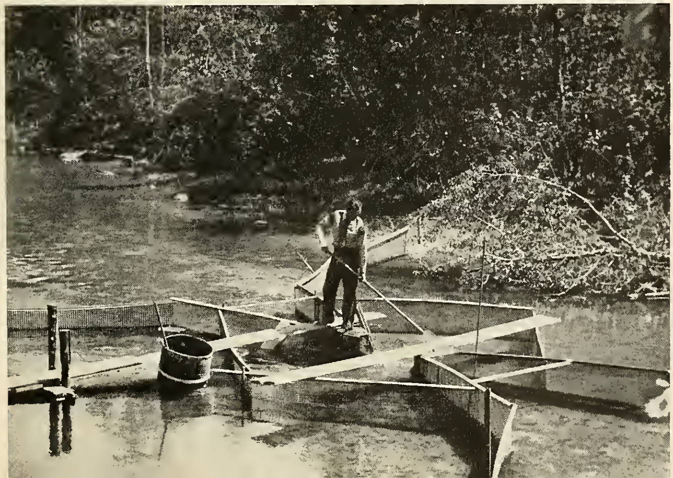
The spread of the big bloodsuckers from their original colony there was not long delayed. The second Lake Erie occurrence was recorded off Sandusky in 1927. Then, in 1930, lampreys were taken from the St. Clair River, linking Lake St. Clair and Lake Huron, and scientists realized the marauders were on the march. Four years later they had swarmed north through Lake Huron and the Straits of Mackinac into Lake Michigan, and that same year the first spawning run was reported in the Clinton River at Rochester, Michigan. The year 1936 saw a lamprey taken in Lake Michigan 15 miles offshore from Milwaukee, and the following spring a heavy spawning run was discovered in the Ocqueoc River, running into Lake Huron 200 miles north of the Clinton. The spread and increase of the creatures has been steady and rapid ever since, and when the first record came in from Lake Superior in 1946, fishery experts knew that the thing they had foreseen and dreaded all along had taken place. The marine lamprey was now established in all of the Great Lakes. From the fact that the Lake Superior specimen was a small adult attached to a lake trout caught off Isle Royale, only a few miles south of Port Arthur, it seemed likely that the lampreys had then been present and spawning in Superior for several years, too, their presence suspected but unproved.

It is now known that there are spawning runs of lampreys in 108 Michigan streams, in every watershed in the Lake Michigan basin, every major watershed north of Saginaw Bay in the Lake Huron basin, and in 5 tributaries of Lake Superior, including a major run in the Tahquamenon River, the "rushing Taquamenaw" of the Hiawatha legend. In addition, they have established themselves in four of Michigan's larger inland lakes, Burt, Mullet, Pentwater, and Charlevoix, where they pose the same threat to bass and other game fishes as to commercial species in the Great Lakes.

Lamprey spawning runs also are annual events now in many Wisconsin streams running into Lake Michigan north of Manitowoc and in several rivers in Ontario in the Georgian Bay area. In 1948, the first Indiana run was reported, in Trail Creek near Michigan City. And last April lampreys were found for the first time in branches of the Little Calumet River, a northern Indiana stream that drains into the Mississippi! They had gained access through a drainage ditch leading in from Lake Michigan. From there the entire Mississippi watershed is theirs to invade if they choose. Whether they will take advantage of the opportunity and spread through this vast new range only time will tell. But at least they have succeeded in vaulting the natural barriers between the Great Lakes and Old Man River.

▼ **Weirs like this one in the Ocqueoc River, to trap the lampreys as they go upstream to spawn, seem to offer the best hope. But the task is tremendous, and there seems little chance that the lamprey can ever be eradicated**

Mich. Department of Conservation photo by W. E. Hastings



Few creatures of the underwater world are more repulsive in appearance or better fitted to pursue a predatory way of life. Ranging in length from 14 to 30 inches, averaging 15 to 18, the lamprey is long, slender, and to a Great Lakes fisherman the symbol of evil. "If it swims like a snake and looks like a length of garden hose, it's a sea lamprey," was the descriptive phrase one research worker coined for the creature a few years back.

The fish has a smooth, scaleless, slimy skin and two short, separate dorsal fins. The ground color of a mature adult is bluish-gray, and in spawning season the lampreys are strongly mottled with yellowish or brownish-orange blotches. A row of seven round gill openings is arranged along each side of the throat like small portholes. The flat "lowbrow" head ends in a round sucker mouth rather than in true jaws. The inside of this sucker disc is armed with sharp, strong teeth which the creature uses, together with its filelike tongue, to rasp away the scales, skin, and flesh of any fish to which it attaches itself. Once the skin is lacerated and the blood starts flowing, a secretion from glands in the lamprey's mouth prevents clotting. The big bloodsucker rides along, feeding on its helpless host, until it has its fill of blood or the victim dies from the attack. The lamprey's period of attachment varies from a few hours to a week, and often it goes on clinging to its host for a time after the latter is dead.

Legend has it that the lampreys were once looked upon as a table delicacy, and Henry I of England is said to have died from eating too many of the creatures. In the Baltic countries of eastern Europe they are still used for food, and before the recent war Finnish immigrants in northern Michigan were importing canned lamprey. To date, however, nothing has come of experiments aimed at utilizing for food Great Lakes lampreys captured on the spawning run.

In 1946, Congress passed a resolution directing the Fish and Wildlife Service to undertake a sweeping investigation of the lamprey and push a program for its eradication. In November of that year the Sea Lamprey Committee, organized by the Service and including conservation officials from Ontario and all of the states bordering on the Great Lakes, got together to map out a campaign.

The lamprey war got under way the following spring, with Michigan, Ontario, Wisconsin, and the Fish and Wildlife Service taking the lead. So far, in two years of study, much that is new has been learned about the lamprey's life history. But to date all attempts to find workable ways to thin his ranks have come to a dead end.

It is fairly well established now that the life cycle of this marine pest ranges from five and a half to six and a half years. The first four or five years of its life are spent in a larval stage in the stream where it is hatched. After hatching, in early summer, it remains in the nest for about a month, by which time it has grown to a length of half an inch. It then moves downstream and burrows into beds of sand or silt for a long, slow period of development. At this stage it does no damage. It looks like a worm and feeds on microscopic organisms carried to it by the current. Growing slowly, it reaches a length of six to eight inches at the end of its fourth or fifth year and is then ready for a metamorphosis that will transform it into the adult, blood-hungry form, much as a tadpole is transformed into a frog.

The eyes develop, the sucker disc is formed, the stout teeth appear within it. When it is fully equipped for adult life, the lamprey quits its silt bed and migrates downstream once more, this time to the lake beyond the river mouth, where for the rest of its days it will prowl and prey on any unfortunate fish of its choice to which it can attach itself.

The adult life of the lamprey is believed to last at least a year and a half. At the end of that time, sexually mature, it is ready to re-enter a stream for the final climactic act of its life. Males and females move up together, fighting their way toward the headwaters in a wriggling horde, taking advantage of the cover of darkness, hurrying on toward the spawning grounds.

The first spawners enter the streams in April; the last stragglers do not make the journey before July in some waters. The peak of the run occurs in May and early June, however, governed by water temperatures.

Men who have seen a pool or gravel bar crowded with the slimy, slithering bloodsuckers say it is not a pretty sight. It's just as well, they contend, that the lamprey runs occur chiefly at night. But for that same reason, sizable runs may develop in a stream without their presence being suspected, a fact that has made much more difficult the task of determining the abundance of the lampreys in the waters of the Great Lakes.

Once suitable spawning grounds are reached, on gravel bottom with a fairly fast current, male and female lamprey together set about the task of building a nest. Moving stones with the aid of their sucker mouths, they excavate a shallow redd 3 to 6 inches deep and 12 to 30 inches across. There the female proceeds to deposit a mass of eggs ranging in number from 24,000 to more than 100,000 and averaging 62,500—which affords some idea of the magnitude of any practical plan for sea lamprey control!

The adult lampreys die after spawning, as do the salmon of the Pacific. The eggs hatch in one to three weeks, and the cycle starts all over again.

At no point along the line of that unusual life cycle has an effective way been found to attack the lampreys. Thus far there seems to be no weak link in the chain of events that brings them from egg to full-grown bloodsucker.

The Great Lakes watershed abounds in rivers and small streams that provide ideal spawning places. The lakes themselves provide an abundant food supply. Blessed by a favorable habitat, lacking natural enemies or other natural checks, and apparently free from epidemics such as often kill off overcrowded forms of wildlife (they congregate in schools only at spawning time), the marine lampreys are doing extremely well in their new environment.

Electric shocking devices, such as are used in fish research work, have been tested and failed. Rotenone poisoning also has failed to kill the larvae in the streams. The poisoning of an entire spawning run has not been tried and probably won't be, since to have the desired effect on the lampreys it would have to render the water of the stream deadly to all fish life for a period of four months, at a heavy cost in food and game fish.

The best control method discovered to date, the experts say, appears to be the use of weirs and traps to take the lampreys as they move upstream to spawn. Several such wiers are now in operation in Michigan, Wisconsin, and Ontario, and it is believed that by the efficient operation of these devices it may be possible to wipe out the spawning run in a stream almost completely. In view of the number of streams where runs are now known to occur, however, plus the strong likelihood that the lampreys are spawning in many other streams as yet unreported, it is obvious that the task of bringing under control this menace to the fisheries of the Great Lakes will be huge and costly.

The Fish and Wildlife Service recently asked Congress for an appropriation of $350,000 to continue the work. Even if this amount, and much more, is forthcoming, and even with the continued co-operation of the individual states and Canada, there is little hope at this point that the job can be completed for many years to come.

Continued from page 398

two groups of palms by their leaf form. In one group, the leaves look like enormous feathers, as in the coconut palm. In the other group, the leaves are fanlike, as in the giant talipot. From the fan-type leaf, palms possibly derive their name, because the leaf divisions radiate out like fingers from the human palm. Another explanation is that the name "palm" derives from the fact that leaves and branches of these trees were carried in the hands of victors in ancient triumphant processions and were bestowed by hand upon the honored one. But as in most flowering plants, real differences between palms exist primarily in flowers and fruits.

One would hardly grow a palm for its flowers. They are inconspicuous and scarcely more attractive than the tiny blossoms of their distant cousins, the grasses. But though small and petal-less, their numbers are legion. The flowers are borne in much-branched, often pendant clusters, which arise from large boat-shaped spathes readily seen just below the leafy crown of most species. A single flower cluster of an average palm measures from two to six feet long, but the enormous terminal flower crown of the Indian talipot (*Corypha umbraculifera*) may easily attain twenty feet in height. Flowers of this palm may number 60 million individuals per plant—real mass production! Conserving energy over a 30 or 40 year period somewhat like a century plant, the impressive talipot, unlike most of its relatives, flowers only once, throwing all its strength into one mighty blossoming splurge. When it has set fruit, it dies. An even more remarkable if yet unexplainable thing about talipots is that in a given region all individuals of this species will flower at one time in gregarious fashion. In June of 1918, from one observation spot in Ceylon, 200 talipots could be observed in flower.

Palm fruits, in size, color, and structure, are as divergent as the familiar dates and coconuts. They range from the size of a small pea to the great mass of a coconut; and the latter is the biggest seed in existence save for that of a relative, the famous double coconut, or coco de mer, of the Seychelles Islands, whose individual fruits may weigh from 30 to 40 pounds.

Commercially speaking, it is the fruit that is the most important part of the palm plant. Many palm fruits are edible, the nutritive portion usually being the kernel, as in the coconut. But in other types, such as the peach palm, the farinaceous pulp surrounding the seed is the portion in demand. Both the external pulp and kernels of palms are the great sources of palm oils, which are called either pulp or kernel oils accordingly. The strategic importance of palms was brought to the fore in World War II when fats, needed as never before for food and explosives—not to mention their use in the manufacture of soaps, tin cans, and sheet metal—were (and still are) at a premium. Palm oil was scarce because most of it is derived from copra (obtained from the distant and then isolated South Pacific islands) and from the kernel oil of the west African oil palms. Distance has lent enchantment to these products, but it has also caused hardship, and unnecessarily, because in our own hemisphere there have always existed larger concentrations of native oil-yielding palms than anywhere else. Thus we have been "carrying coals to Newcastle." For besides the coconut and African oil palm, both of which are found cultivated in large quantities in tropical America, there are at least 25 other important native oil palms in South America alone. Fortunately, there are signs that our country is now aware of this hemisphere's own wealth of oil yielders, for many

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of these all-American species are now coming to the front commercially. Their native Indian names—babassú, tucum, ouricury, murúmurú, dendé, cohune, corozo, and bacába—to name a few, sound like a voodoo chant. Latin-American countries, particularly Brazil, have begun to take note of their wealth in oil palms, and companies like United Fruit are investigating the possibilities of one of the American tropics' greatest potential export crops.

The economic possibilities in palm culture have mostly centered in the species supplying oil but are not limited to them. We think of cane as the principal source of our sugar supply, yet in the Far East palm trees produce one billion pounds of sugar yearly. More than a dozen sugar-producing palms are known in southern Asia alone; and as many potential yielders probably grow in our own hemisphere. Sugar-yielding palms are a perennial crop that needs no harvesting as do cane and beets. Like maple trees, these palms are merely tapped for their sugary exudate. It has been said that the world's saccharine palms, if properly tapped, could produce more sugar than all the other sugar-yielding crops combined!

It is easy to see what a wonderful society palms are: they have paraded across the pages of history; they are supplying our civilization with some of its most important plant products; they have long nourished the races of the tropics; and at the same time, they have cloaked the wild and cultivated gardens of those regions with a green elegance unmatched by any other type of plant. Surely they amply fulfill the billing given them by the great botanist Linnaeus, when he denominated them as *Principes* or "Princes" among plants.

GIANTS OF THE ANIMAL KINGDOM

Continued from page 423

for weight-carrying, the development of strong, heavy legs to support the body against the constant downward pull of gravity.

So we see there have been many giants on the earth during the long evolution of life. There have been real giants among the fishes, reptiles, and mammals and lesser giants among other backboned animals. There have been giants in the water and on the land, and giants of a sort in the air. The role of the giant has been tried time and again by various animals, and it has raised its difficulties, the difficulties of sheer mass, physiology, temperature problems, and food supply. But it has given to the giants certain advantages, particularly the advantage of immunity from attack. Giants, because they are giants, are seldom molested except by other giants. Giantism as a way of life, therefore, has been very successful for certain groups of animals.

It should be noted, however, that although various animals have been giants, men, in spite of the proofs offered by Bernal Diaz del Castillo, have never attained the stature of real giants. Why should this be?

To answer this question briefly, it can be said that Man is a primate, and the primates through their evolutionary history have been tree-dwelling or climbing animals. Because of their mode of life and because of their adaptations to this mode of life, true giantism has been for them something unattainable. Of course there have been giants after a fashion among the primates, and these include Man, the gorilla,

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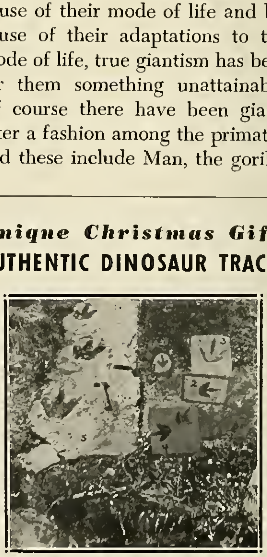

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the orang, and the chimpanzee. But none of the primate giants are real giants like the elephants or the dinosaurs of the past. Therefore, the stories of giant men must remain as legends, to delight us as we read them in fairy tales.

If Man is not a giant in stature, he has attained a sort of giantism that has never been equaled by any other animals. This is the giantism of intellect. Man is the intellectual giant of all time. He is the inquisitive giant, to whom all the world and its things form a vast puzzle and as such, a challenge. Being a curious creature with a giant intellect, Man has set for himself the task of learning as much as he can about the world around him. That is how he has learned about the physical giants of the earth, the giants that lived in past ages and the giants of today.

BOOKS

Continued from page 391

Dr. Simpson divides his work into three parts. In the first part, which he calls "The Course of Evolution," he makes a brief survey of evolution, especially as concerns the higher vertebrates, with particular emphasis on the reptiles, the mammals, and the primates. The evolution of life through geologic time is briefly outlined, and it is shown that evolution has proceeded at different rates in different lines of animals and at different stages in their histories. Animals and plants have taken advantage of the opportunities open to them to fill the earth with organisms adapted to all manners of existence, and this has resulted in an increase both in variety and numbers.

The second part of the book, "The Interpretation of Evolution," will be of particular interest to students of biology and geology. Such things are discussed as oriented evolution, evolutionary opportunism, racial life and death, forces of evolution, and the concept of progress in evolution. Dr. Simpson rightly rejects all vitalistic theories as to oriented evolution and shows quite clearly that the one factor leading to nonrandom evolution is adaptation. He then goes on to show how evolution is highly opportunistic—how evolving animals utilize the structures that may be developing within their particular lines, even though these structures may not offer the most perfect mechanical solutions of the functions for which they are adapted. In an illuminating discussion of extinction, he shows that there is no single explanation to account for this phenomenon; rather, extinction is the result of the interaction of changes in environments and changes or lack of changes in the organisms. The forces of evolution are those revealed by the study of modern genetics. There are various definitions and measures of progress in evolution; perhaps the best that can be said is that change toward a particular sort of organism best adapted to its own way of life is the most objective criterion of progress.

In the third part of the book, "Evolution, Humanity and Ethics," Dr. Simpson discusses the moral implications of his work. He concludes that there is no absolute ethic available to Man. The ethical concept is in itself a result of evolution and must be based upon choice in accordance with the mental and moral development of the individual. Dr. Simpson's measure of ethics is based to a large degree upon knowledge and responsibility. The growth of human knowledge and the attainment of a high degree of responsibility are the good things of life.

All in all, this is a profound and thought-provoking volume that should arouse a great deal of interest among both scientists and laymen. It is unfortunate that the format of the book has resulted in the reduction of the figures to such a scale that in some of them the lettering is not easy to read.

EDWIN H. COLBERT.

MAINE BIRDS

- - - - - by Ralph S. Palmer

Museum of Comparative Zoölogy
Cambridge, Mass., $5.00
656 pp., 3 maps

IN this historical review of the birds of Maine, Dr. Palmer, himself a native of that state, has brought to completion a task begun by the late Arthur H. Norton of the Portland Society of Natural History. The distribution and status, past and present, of Maine birds is very carefully set forth. There is also a wealth of information on nesting habits and general ecology, but this volume is not intended to be a popular handbook and gives no aid in species indentification. It will, however, be indispensable to those interested in the birds of Maine.

D. AMADON.

LETTERS

Continued from page 386

perfidiously snipped the flattened cones with her sharp, kris-edged jaws, and proceeded to regale herself on the nectar secreted nowhere else! The sequence was repeated time after time with practiced precision; so it was not just happenstance but routine procedure. And the mystery of the mutilated flowers was solved!

Never save that once have I seen that highly diverting and thought-nudging performance, nor any evidence of it. There are no witnesses to vouch for my veracity; but most assuredly I am not romancing. It would require an imagination far more fertile than mine to fabricate an incident so nearly incredible yet wholly within the realm of reality. Fact may indeed be stranger than fiction!

Other flowers, notably those of the columbine or honeysuckle, with the nectar at the bottom of the much longer and slimmer spurs, might well tempt an insect to sidestep Nature's rule of reciprocal service; but I have never found their larders thus rifled.

Her majesty was cheating, of course. And while wrong-doing is never a privilege even of royalty, surely her cleverness ought to extenuate her! Moreover, there must have been plenty of other bees thereabouts to discharge in orthodox fashion the duty she had shirked.

Had she merely stumbled upon that easy short cut to the delectable hoard, which her highly specialized olfactories were unerringly keyed to locate? Or was it a flash of genius, the awakening of individual initiative—dramatic and unique? *You* tell!

E. P. ANDREWS, M. D.

Portage, Wis.

The following answer is offered by Mr. Herbert F. Schwarz of the American Museum's Department of Insects and Spiders:

The interesting observation recorded by Dr. Andrews is not without precedent. In the Old World, the short-headed *Bombus mastrucatus* employs the same technique in nibbling its way to the nectar deposits of *Aconitum lycoctonum,* while in America there are at least two bumblebees—*Bombus affinis* and *Bombus terricola*—that also secure nectar in this illegitimate manner. Both of these species are characterized by an extremely short head coupled with a short tongue. Because of their structural inadequacy, they cannot readily secure the nectar of long-tubed flowers in the usual manner but are forced to perforate them. That the habit of chewing a passage to the nectar is correlated with the length of the tongue receives support from the observations of the late Otto E. Plath, who noted that

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the workers of *Bombus affinis* perforated the flowers of red clover whereas the longer-tongued queens of the same species as a rule obtained the nectar of the red clover in the approved way. The same observer noted, however, that queens and workers of *affinis* and of *terricola* would in some instances pierce the flowers of rhododendron even though other members of their caste and species were securing nectar without doing violence to the bloom. Here there was persistance in a habit formed under necessity even after that necessity had ceased to exist.

The nefarious habit of mutilating plants in order to drain them of their nectar is not wholly confined to the bumblebees. Among the stingless bees (Meliponidae) of the tropics, *Trigona* (*Trigona*) *ruficrus,* which occurs in Brazil and in Paraguay, has been accused by both H. von Ihering and Marianno of perforating the area of the plant where the nectar is located. Although *Trigona* (*Trigona*) *fulviventris* has not been observed "jimmying" its way into the floral treasure room after the manner of the burglaring *ruficrus,* it is not reluctant to share the nectar that such acts of housebreaking make available. Dr. J. C. Bequaert wrote me that in Guatemala he observed *fulviventris* stealing the nectar of the cultivated coffee plant through perforations in the tube of the corolla that had been made by some other despoiler. Even the highly reputable honeybee sometimes becomes an accessory after the fact by lapping up the residue of liquid left after the forcible entry of an earlier visitor.

Conservation at Lake Success

WHAT may well be regarded in years to come as the most important world conference to date took place at Lake Success during August and September. At the invitation of the Social and Economic Council of the United Nations, over 700 scientists from over 50 countries gathered to discuss the techniques for achieving wise resource use. Over 500 scientific papers were prepared for the Conference and distributed to the participants in advance.

Much of the work of the Conference was carried on in section meetings devoted to special phases of the problem, such as those relating to fuels and energy, water, forests, land, wildlife, and fish. Having read the papers in advance, the participants were free to devote all their time to a discussion of the more baffling aspects of the various problems raised in the papers. One of the most interesting aspects of these discussions was the great similarity in conservation problems the world over. The United Nations' superb facilities for conference work did much to facilitate the free interchange of ideas and largely erased the usual language barriers.

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Out of the Conference will come a set of transactions available in several languages in which will be reproduced both the papers submitted and the discussions concerning them. These transactions will be available to all who are interested in the problem of resource use and will represent the Conference's main accomplishment.

The broader problems of world resources were covered at plenary sessions. These highlighted the question of how the world was going to feed its anticipated three billion population in the year 2000. They also brought out the disturbing fact that our American high standard of living requires for its maintenance such huge quantities of relatively scarce and nonrenewable resources like copper, nickel, zinc, and lead that we are sucking in a large part of the total world's supply —a supply that would last only a matter of one to five years if the whole world were drawing on it at the rate we are.

Although not authorized to pass any resolutions or reach any final conclusions, the Conference made it abundantly clear that the real problem does not lie in the realm of science and conservation technique, but in the fields of politics, economics, and sociology. The world's scientists are well advanced in the task of learning how to handle the lands that produce our renewable resources so that they will be at least as productive a half century from now as they are today. They also had many suggestions concerning the more complete extraction of scarce metals from ore bodies, the more efficient salvage and re-use of such metals, and the wisdom of forcing the use of substitutes before the present ore deposits are exhausted. Even in the marine resources that are used by all and therefore have been no one's responsibility, some progress has been made.

Unfortunately, there was a notable absence at the Conference of those who could suggest how the people and nations of the earth could be induced to put modern conservation techniques into practice in time to save the not inconsiderable portion of the earth's cultivated land that will no longer be producing by the year 2000 if present rates of erosion and exhaustion of fertility are not promptly checked.

Concurrent with the Conference at Lake Success on the conservation and utilization of resources, UNESCO and the newly formed International Union for the Protection of Nature held a conference on nature protection. The very fact that a world conference on such a subject was called under UN sponsorship was a great achievement. For years, small groups in almost every country have been fighting what has often seemed a hopeless battle to save some remnant of the world as nature made it. For representatives simply to meet each other face to face to exchange views and experiences and plan for the future was an inspiring experience.

This Conference was less bound by limitations than the larger one and in a sense was more realistic, as much of its attention was devoted to the need for public education on the subject of nature protection. At its final session an excellent set of resolutions was formulated and adopted. At the various section meetings attention was directed to the need for more basic ecological research and more attention to the over-all effect on the environment of large-scale "planned enterprises." At a meeting on the problem of exotics there was complete unanimity of opinion on the inadvisability of introducing any plant or animal into an area where it had never been present and therefore had never had a chance to evolve a harmonious relationship with the other organisms of the area.

Several meetings were devoted to the problem presented by the larger mammals, and methods were considered whereby they might be preserved in an increasingly civilized and densely populated world. Attention was also given to the problem of how at least samples of all the primitive world's rich fauna and flora could be saved for future generations.

The 22 resolutions passed by the Conference highlighted these problems and called upon the various national governments and UNESCO to give wider recognition to them. Unfortunately, the International Union for the Protection of Nature, co-sponsor of the Conference, and the one organization that might follow through on these matters on an international scale, is still without the financial means even to stay alive.

The Conference made it clearer than ever that the impact of our modern technological civilization on even the most remote, out-of-the-way corners of the globe is such that, less than 100 years after Darwin first opened our eyes to the natural processes that over millions of years produced the complex biotic communities of the world's various continents, we are on the verge of utterly destroying many of them. Although we have made a start on classifying and naming the species of plants and animals that form the cogs in these complex assemblages, we still know little of the real role of each species in the life of its community, nor have we even scratched the surface in understanding the natural laws that produced and regulate these wonderfully stable, climate-dominated, land-occupying superorganisms.

RICHARD H. POUGH.

December **NATURAL HISTORY** *1949*

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LETTERS

Père David's Deer and the European Bison

In response to our recent article entitled "The Story of the Milu," the following informative letter has been received from the Duke of Bedford:

Sirs:

I have read with great interest the article on Père David's Deer in the October number of Natural History.

By the discovery of a good many subfossil remains, it is, I think, now definitely established that the original wild habitat of this animal was in the Honan district of China and the middle reaches of the Yellow River. The antlers appear, in some cases, to have been used as primitive implements by the human inhabitants of the period, just as in Europe Red Deer antlers were used for a similar purpose.

I was glad to hear recently that the four young Père David's Deer reached Australia safely.

Your article also refers to the European bison, and I might say that by far the largest surviving remnant of this animal exists in Poland, where I believe, there are 90 animals. There are also a few in Sweden, a few in Germany, and one or two in various continental zoological gardens. The Woburn herd at present numbers fifteen, and I hope to obtain shortly a new bull from Poland.

I always feel a little sorry that the United States, with its great facilities for success in this direction, is not doing much to preserve, on its own territory, the many fine species of deer and other animals from abroad that are at present being threatened with extinction in their native habitat. Although admirable work is being done for the preservation of rare American species, foreign species seem to be neglected, partly as a result of lack of interest on the part of those who might undertake the work, and partly because of the extremely unhelpful attitude of the authorities. Like their counterparts in some other countries, they suffer from a most exaggerated complex with regard to the danger of introducing cattle disease by the importation of foreign ruminants. With reasonable quarantine precautions, there is not the slightest danger from this source. Indeed, most of the serious cattle diseases have such a short period of incubation that, even without any special rules with regard to quarantine, the conditions under which wild animals are usually imported, singly, in crates, themselves prevent infected specimens from reaching a new continent if they come by sea and not by air.

Bedford.

Woburn, Bletchley,
Bucks, England.

NOTICE—Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on these pages will be paid for at $3.00 each, with full credit to the photographer. Return postage must be included.

Photo by Josef Muench

▲ Mountain Symphony in White. The open road beckons the motorist to study nature in her least known mood. The Grand Tetons in Wyoming

The Secret of Thalessa

Sirs:

I was interested in your article, "Drillers of the Insect World," in the October issue. You mentioned that the parasite locates the larvae of the horntail inside the wood of the tree by methods not yet explained. This past summer I had a good view of the parasite of the horntail in the process of laying its eggs in a tree by our house in Bucks County, Pa. It seems quite obvious to me that the parasite locates the horntail's larvae by means of its antennae. We watched this strange-looking insect carefully going over the bark of the tree with its "feelers." Once it had decided on a place, it went through extraordinary gymnastics, seizing its very long ovipositor with its two rear legs and drilling the hole. The insect practically stands on its head while laying its eggs, and the ovipositor makes a long, complicated loop. When it begins to pump the eggs, this loop becomes filled in with a thin membrane. The insects were busy about this tree throughout August, and we even saw them flying around as late as September.

Alice L. Hopf.

New York, N. Y.

It is possible that the parasite *hears* the larvae as they feed inside the wood.
—Ed.

The Christmas Star

It has become a tradition that during December visitors to the Hayden Planetarium will see time turned back nearly 2000 years and enjoy the skies as they shone near the time of the first Christmas. Several interesting theories about the Bethlehem Star will be discussed and illustrated. The program this year promises to be more elaborate and exciting than ever before.

Tiger Beetles, Silver-striped Scarabs, and Fighting Scorpions

Expeditions during the summer and fall have raised the American Museum's insect collections to a total of more than 2,700,000 specimens, it was recently announced by Dr. Mont A. Cazier, Chairman of the Department of Insects and Spiders.

One element in the recent increase was what has been called the finest single collection of Tiger Beetles ever secured—7000 specimens collected by Dr. and Mrs. Charles Vaurie during a 12,000-mile trip. The Tiger Beetle ranks among the most wary insects and shows remarkable resourcefulness in eluding the collector. The collection includes 99 of the unusual

White Tiger Beetles, which will furnish valuable information on the evolution of these insects.

Dr. Willis J. Gertsch, who concentrated on the Rockies and western deserts, collected 20,000 specimens, including more than 4000 spiders and scorpions. He secured several specimens of a scorpion rarely taken in this country—the rare "Wind Scorpion," popular among the Arabs as a "prize fighter." It is only about one inch long but has very large jaws. Dr. Gertsch also brought back a number of primitive six-eyed spiders, or "weaver spiders," whose cocoons, woven from leaves, have rarely been collected for scientific study, though they are fairly common in the Arizona desert. Most beautiful among his treasures, however, is the very rare light green scarab beetle, *Plusiotus gloriosa,* which wears a series of bright silver stripes. It is known as one of the most handsome insects. The importance of photographic work on field trips of this nature is indicated by the fact that Dr. Gertsch alone took more than 1700 pictures.

Another collection of several thousand Tiger Beetles was gathered in western Mexico by Mr. and Mrs. George Bradt, of Tucson, Arizona, bringing the Museum's total collection of Tiger Beetles to about 80,000.

Edwin Way Teale's Photographs

About 60 selected photographs by the author of *Grassroot Jungles* and other outstanding books will be displayed through January 3 at the American Museum, in a special exhibit entitled "Insect World." In addition to his prominence as a nature writer, Mr. Teale is an Associate of the Royal Photographic Society in London, and a number of his photographs are now on exhibition there.

Ancient Ghost City Found in Afghanistan

A "lost city" covering an area of about five by six miles and showing every indication of having been abandoned suddenly many, many centuries ago has recently been discovered by an American Museum expedition exploring an inaccessible section of Afghanistan.

This most extraordinary ghost city is estimated to have had perhaps as many as 100,000 inhabitants. Household articles such as cooking utensils and furniture were found just as would be expected if the population were suddenly forced to leave. Houses, fountains, aqueducts, and irrigation ditches remained almost intact. Even the ancient fort stands in defiant but silent defense of the empty desert metropolis. Preliminary estimates indicate that the city flourished around the time of the Crusades.

The expedition, under the leadership of Walter A. Fairservis, was crossing the fabled Dashti-Margo, or "Desert of Death," in the southwestern section of Afghanistan when the remarkable discovery was made. Accompanying Mr. Fairservis on the 6000-mile journey by jeep and trailer were Louis Dupree, graduate student in archaeology at Harvard University, and Henry W. Hart, an architect and graduate student of Yale University.

Though it seems strange that such a conspicuous landmark had not previously been reported, it is to be remembered that this is one of the least known parts of the world. The area is practically unknown even to the Afghan people.

According to native legend, the city was probably abandoned when an invading force cut off the water sources, rendering survival impossible. However, Mr. Fairservis points out that the wells of the ghost city are completely dried up, and he is more inclined to attribute the evacuation of the city to a sudden climatic change. Further study in this area may thus support the theory held by some scientists that basic migrations, sometimes affecting large geographic areas, are often caused by climatic change. It is thought by certain Afghan scholars that this is the once great city of Peshawarun, often mentioned in legends, and that its residents trekked some 700 miles over deserts and mountains to become the founders of the modern city of Peshawar on the northwest frontier of India.

It is hoped that an article will soon be published in NATURAL HISTORY giving a full account of the discovery. Mr. Fairservis hopes to return to the area next summer with a complete staff of archaeologists to begin more intensive examination and study.

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Remember the Sugar Pines

Readers will recall that NATURAL HISTORY Magazine carried information about the danger threatening the Sugar Pines of Beaver Creek Valley, in the February, April, May, and November issues of last year.

In a beautiful section of California, this tract, which is less than three miles long, contains the world's finest remaining examples of the Sugar Pine. Some of the trees are 8 feet or more in diameter and from 200 to 240 feet tall. Without the intercession of strong public opinion, this forest will be cut for commercial use.

To keep our readers up to date on this situation and to urge every possible action for the defense of these trees, we publish the following communication recently received from John B. Elliott, President of the California War Memorial Park Association:

Does Public Opinion Really Count?

One answer to that question is the long, hard fight of the California War Memorial Park Association, Inc., to preserve the magnificent Sugar Pines and giant Sequoias of Tuolumne County in California as a War Memorial Park.

This Association, composed of the leading citizens of California, has been fighting for this project for almost two years. Endorsements of their endeavors include every state veteran's organization, both A.F. of L. and C.I.O., and hundreds of other leading state-wide organizations. The total membership of the organization endorsing this worthy project is more than 2,500,000 persons.

On the other hand, the program is opposed only by a lumber company and its henchmen. Yet, after almost two years one wonders if the California War Memorial Park Association is really any nearer the goal they set out to achieve.

How a lumber company that was assisted by a government R.F.C. loan when it was at its lowest ebb can ignore the wishes of 2,500,000 people is not understandable. Nevertheless, that is what is taking place. This lumber company has resorted to every conceivable means to "submarine" the genuine and sincere efforts of these California citizens.

The California Congressional delegation recommended to Secretary of Agriculture Brannan last March that he take over the area. The Governor of California has committed the State for $500,000, or if necessary a larger amount, to purchase the area from the Federal Government after the Secretary of Agriculture has taken possession from the private owners. Yet this lumber company, the project's only real opposition, has been able, through the U. S. Forest Service, to delay, confuse, and further delay the Congressional recommendation.

If the lumber company were to lose in the end, one might understand its reason for some resistance to the plan. But under the Statute of 1909, the company will receive other Federal-owned timber in exchange for this unique area. The lumber company cannot lose.

The decision rests entirely with Secretary of Agriculture Brannan, and if public opinion really counts, the California War Memorial Park Association will win its long fight.

The question, however, remains unanswered, and one wonders.

Does public opinion really count?

NATURAL HISTORY

The Magazine of the American Museum of Natural History

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VOLUME LVIII—No. 10
DECEMBER, 1949

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An airplane with collapsible wings has challenged man's ingenuity, but the rove beetle perfected such an arrangement ages ago

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Refugee Pelicans of the Desert............Lewis W. Walker 471
Far from their usual haunts, they struggle to raise their young beneath blazing skies on the transient islands of Salton Sea

You will find Natural History Magazine indexed in *Readers' Guide to Periodical Literature in your library*

THE COVER THIS MONTH

Cactus flowers are among the most beautifully textured creations of nature. Coming in all colors except blue, they shine like fine silk and satin. Many last only for a single night, while some remain open for three or four days. Among the chief beauties are the species of *Echinocereus*, commonly called hedgehog cactus, whose flowers run the entire range of cactus colors. They are native from Oklahoma and Wyoming to California and as far south as Mexico City.

Echinocereus polyacanthus, depicted here, has a wide occurrence in the southwestern United States and adjacent Mexico. The plants grow in clumps of several spiny-armed stems up to one or two feet tall and two to four inches in diameter. The bright red flowers remain open day and night for about four days and in due time are followed by spiny red fruits. These look like giant strawberries and are responsible for the common name, strawberry cactus. The spines are easily removed, and the fruits, when cooled in the refrigerator and eaten with cream and sugar, have a delicious flavor.

E. J. Alexander.

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AMERICAN SPIDERS

- - - - - - - by Willis J. Gertsch

D. Van Nostrand Co., $6.95
272 pp., 111 photos,
44 in full color

FOR generations, an attitude of unthinking anthropomorphism has attributed "cruelty" and "deceit" and "evil" to the spider. Popular prejudice verges on a phobia. It is to be hoped that Dr. Gertsch's informative and superbly illustrated book will lead readers to examine from a fresh viewpoint the value and interest inherent in spider life.

American Spiders is the second volume in the New Illustrated Naturalist series, begun under the editorship of the late Dr. Clyde Fisher. It is also the substantial by-product of more than two decades of field and laboratory research by one of the world's leading spider biologists. Dr. Gertsch's book covers the evolution of spiders, their relation to other arthropods, their life cycle and structure, their medical and economic importance. It tells of the love dance of the males, the ballooning of the spiderlings, the bizarre mating habits of one species in which the female is half an inch long and the male the size of a pinhead. It stresses the importance of spider silk—able to stretch a fifth its length without breaking, second only to fused quartz in tensile strength, yet so delicate it is sometimes produced in threads only one-millionth of an inch thick. It deals with such diverse spiders as the orb weavers, the fishers, the tarantulas, the blind spiders of Mammoth Cave, and the bola spiders that use a thread weighted at the end with a drop of liquid silk to capture their prey in the manner of a Gaucho using a bola.

The full-color plates and dramatic action shots, such as Walker Van Riper's speed picture of a jumping spider in midair with its dragline playing out behind it, are, in themselves, real contributions to spider study. Well-printed, well-illustrated, and carefully written, Dr. Gertsch's book is, and is likely to remain for years to come, *the* book on the natural history of North American spiders.

EDWIN WAY TEALE

THE AWAKENING VALLEY

- - - - - by John Collier, Jr., and
Anibal Buitron

University of Chicago Press, $6.00
199 pp., 167 illusts.

SUCH census figures as are available indicate that there are roughly seven million Indians living in the Andean areas of Colombia, Ecuador, Peru, and Bolivia. Because of the nature of this terrain, many exist only by a subsistence agriculture involving prodigious physical effort. The tangible rewards are so slight that the natives by necessity must adhere closely to a pattern of life fixed centuries before the Spanish conquest. Although many popular articles have been written about this region, few serious anthropological studies are available, with the result that most of us have only a hazy concept of what life there actually involves. The present splendid volume, planned for popular use but of great value to anthropologists, will do much to dispel this ignorance. I hope it will be widely distributed and used.

Its theme is the story of the people of one valley in Ecuador, a people who, in spite of what to us would be abject poverty, are evolving a vigorous economy of their own. This without any governmental or other outside assistance. The remarkable and thrilling aspect is that these people are typical Andean Indians and that what they are accomplishing could so easily be achieved elsewhere in the region.

The story is simply told with 167 remarkably beautiful and well-chosen photographs and with 60 pages of text in addition to captions. It is an extremely honest and unemotional appraisal covering virtually every phase of life. Congratulations to the authors and to those who made its publication possible.

JUNIUS BIRD

INDIANS OF THE URBAN NORTHWEST

_ Edited by Marian W. Smith

Columbia University Press, $6.00
370 pp., 12 pls., 16 figs.

THE term "urban northwest" refers to that great metropolitan area stretching from Vancouver, British Columbia, to Olympia, Washington. Before the coming of the white man, this region formed a portion of the traditional territory of the Coast Salish Indians who, surprisingly enough, have adjusted better than most tribes to twentieth century life.

The present book is a compilation of fourteen papers dealing with the Coast Salish from several distinct points of view. It is not intended to serve as a definitive work on these tribes; rather, as the editor states, "—this book was written for people who already know something about the Pacific Northwest and who want to know more." Yet, in spite of omissions and an essential lack of unity, the book manages to characterize the essentials of Coast Salish culture in a way seldom achieved in the conventional ethnological monograph.

In addition, this book will give the layman an idea of some of the principal approaches devised by anthropologists for the study of mankind in general. Thus selections included fall within such generally recognized branches of anthropology as ethnology, archaeology, physical anthropology, and linguistics. Newer interests of anthropology are also represented by chapters dealing with child behavior, diet, and an excellent autobiography of a Coast Salish medicine man.

The adaptation of the Indian to present-day culture is stressed throughout. Before the coming of the Whites, the Coast Salish was astute in his business dealings and accustomed to economic specialization. Although industrious, he was fond of comfort; and to him cleanli-

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"Anyone, from a Gotham cliff-dweller to a rancher by the Rio Grande—who has even a casual interest in his arachnid fellow-Americans—will find the answers to many of his questions in this book . . . The photographs are technically and artistically superb."
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AMERICAN SPIDERS

by Willis J. Gertsch

American Museum of Natural History
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ness (even in economics) was next to godliness. These traditional values clearly stood him in good stead in his adjustment to modern American civilization.

HARRY TSCHOPIK, JR.

NORTH AMERICAN WATERFOWL

- - - - - - by Albert M. Day

Stackpole and Heck, Inc., $4.75
329 pp., 59 illusts. and maps

HERE, in one volume, is the story of a continent's waterfowl—their once fabulous abundance, the merciless hunting to which they were subjected, their decline, and finally the modern era of protection, refuges, and closely regulated hunting. Its author, the present Director of the U. S. Fish and Wildlife Service, joined that organization some 30 years ago, at about the time when it was first charged with responsibility for safeguarding waterfowl.

He details the history of protective legislation, starting with the largely ineffective state laws and culminating in the migratory bird treaties that we are still in the process of negotiating with our Western Hemisphere neighbors. The bulk of the book is devoted to a full explanation of the vast machinery that has evolved in the past fifteen years for restoring and maintaining waterfowl breeding and wintering grounds, checking on their populations, and regulating the hunting seasons.

Few duck hunters and still fewer ordinary citizens realize how much time and effort go into the job of setting each year's hunting dates and bag limits so that they will safeguard the breeding population and yet permit a reasonable harvest of the animal crop. A reading of this book should have a salutary effect on those self-constituted experts who always insist that there are plenty of ducks and that they know more about the matter than a lot of "Washington bureaucrats." With the results from the banding of thousands of ducks, the running of countless breeding marsh transects both on the ground and from the air, careful winter counts, and many other sources of precise information, the Fish and Wildlife Service knows just about how many ducks they can safely permit the continent's hunters to harvest each fall. Especially interesting to many will be Mr. Day's explanation of the factors that led to the division of the continent into four flyway zones, each with its own specific seasons and bag limits.

The most outstanding areas in the vast waterfowl refuge system set up by the state and Federal governments are described and their importance indicated. It is interesting to learn to what a considerable degree most of them have been improved as waterfowl habitats by the expert management of the Service's biologists and engineers. The author also stresses the important role that the states have played in recent years, using funds made available to them by the Pittman-Robertson Federal Aid program. The figures show that some 22% of these funds have gone into waterfowl work since the program's inception.

The final chapter, "Your Waterfowl," concludes with a plea for better law observance and should be read by every American who hunts or fishes.

RICHARD H. POUGH.

TWILIGHT IN INDIA

- - - - - - by Gervée Baronte

New York Philosophical Library, $3.75
382 pp., 11 plates

THE publisher informs us that the author of this book "has lived many years in India," that she "treats mainly of Hinduism, the most hopeless conglomeration of superstitions since the world began," and that she "aims at exposing the insanity and the filth that is corrupting two-thirds of India's population."

Not even the most ardent admirer of Indian civilization will deny that it has more than its fair share of dark spots. However, there is a difference between unbiased, understanding criticism and the placing of one-sided emphasis on the less savory traits of a people and their civilization, thereby producing a picture that is completely out of focus. The author seems to have taken particular delight in ferreting out all that is objectionable (or what to her seems objectionable) in Hindu life and religion. She rarely misses an opportunity of inserting some unnecessary critical remarks. Her naïve statements and interpretations show that she lacks the anthropological and historical background that might have given her a better understanding of her subject. Since she rarely mentions her sources, it is often not clear what she has read, what she has seen herself, and what she heard from her friends. Most of the chapters on castes and hill tribes seem to be condensed from Thurston's *Castes and Tribes of Southern India* and similar works. A few of the author's own observations would be of some interest, could we only be sure that they are correctly reported. However, the numerous unwarranted generalizations, inaccuracies, and outright misstatements contained in the book cannot fail to arouse our suspicion. The case of the frontispiece is typical. It shows an image of Gangâ, the goddess of the river Ganges, as pronouncedly female as only an Indian goddess can be. Yet, the label assures us that this is "the god" of the Ganges.

ROBERT HEINE-GELDERN.

THE LOST PATHFINDER—ZEBULON MONTGOMERY PIKE

- - - - - - - - by W. Eugene Hollon

University of Oklahoma Press, $3.75
240 pp., 12 illusts.

BECAUSE of the mountain itself and the famous slogan, "Pike's Peak or Bust," the adventures of Zebulon Montgomery Pike are of interest to most of us.

In *The Lost Pathfinder* Mr. Hollon has a good story to tell, although he is too much the professional historian to indulge in much speculation or embroidery of fact. The first part of the book is a bit dull, because too much background material is crammed within too little space.

Pike's first expedition, 1805-1806, was as disappointing in accomplishment as it is to read about. He completely failed in his three objectives but returned feeling complacent about his achievements. In 1806-1807, he led the first American expedition across the Great Plains and into the Rockies to find the headwaters of the Arkansas River. The hardships his party encountered are almost unbelievable, and

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the fact that Pike saw his mountain by accident, and never did reach its summit, seems somewhat pathetic.

It still is not known, despite Mr. Hollon's meticulous search, what the actual purpose of the trip was, or why Pike behaved as he did when he invited capture by Spanish troops above Santa Fé. His subsequent travels through Mexico and his return to the United States to find himself an object of suspicion over the Wilkinson-Burr conspiracy provide interesting reading. After several years of trying to advance himself in the army, Pike was killed, a general at the age of 34, during the York campaign of 1813.

Through the maze of facts, dates, and footnotes in this book, there gradually emerges the picture of Zebulon Montgomery Pike. He was a good soldier, brave with the courage of ignorance, blindly loyal to his friends, egotistical, and quite without humor.

Many readers may feel a slight irritation that such a man should have so great a monument.

MARTHA R. BOGERT

SCIENTIFIC AUTOBIOGRAPHY AND OTHER PAPERS

- - - - - - - - - - - - by Max Planck

Philosophical Library, $3.75
192 pp.

IT is idle to argue whether Einstein or Planck was a greater physicist. Both have profoundly altered our concepts of the physical world. Planck's quantum theory was such a radical departure from previous theories of radiation and other forms of energy emission that it seems interesting to know how it was ever discovered. This, Planck tells us step by step in his very informative autobiography. His epoch-making theory was conceived and published in 1900 when he was 42 years old, 21 years after he had earned his doctor's degree. It was the last step of a long chain of studies and considerations rather than a sudden flash of genius, as are so many discoveries of young physicists.

The other four essays of this attractive little book deal with subjects that are best described by their titles: "Phantom Problems in Science," "The Meaning and Limits of Exact Science," "The Concept of Causality in Physics," and "Religion and Natural Science." I found the discussion on causality particularly stimulating, a subject of very acute interest to physicists ever since the establishment of the Uncertainty Principle by Heisenberg. Planck shows that there is a conflict between those who consider causality as absolute and those who consider it merely a statistical phenomenon. This conflict can be ideally resolved (though never practically!) by recognizing the observer as the chief variable. As an organizing principle, the law of causality has lost nothing of its usefulness. In the final essay Planck states his belief that religion and natural science are allies in a battle against scepticism, dogmatism, and superstition.

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Every reader of these essays by one of the great thinkers of our time will be greatly stimulated, whether he agrees with all of his conclusions or not.

E. MAYR

TRODDEN GLORY

The story of the California Poppy, with a description of some Russians

- - - - - - - - - by Cameron Rogers

Wallace Hebberd, Santa Barbara, Calif.
130 pp., 3 illust.

THIS book is mainly a history, vividly told, of the American west coast between California and Alaska, at the height of the Russian trading era between the years 1790 and 1835. Woven into the account are stories of the lives of the three eminent botanists, Menzies, Von Chamisso, and Douglas. The California poppy, which all three shared in making known, opens its flame-colored petals here and there through the chapters and serves as the tenuous thread on which this somewhat rambling book is strung.

One chapter each is given over to the two Scots: to Menzies, in honor of whom the plant *Menziesia* was named; and to Douglas, of Douglas fir fame. The body of the book is concerned with von Chamisso and many colorful and sometimes violent characters—particularly the Russians, Romanzof, Shelikof, Baranof, and Kotzebue. Side lights are thrown on a variety of matters related to those early colonizers of western America, including the near-extermination of the sea otter; the slaughter of the fur seals and walrus; the behavior of the Kolosh and other tribes of Indians; the early missionaries—particularly Father Juvenal; and the development of the Russian colony at Bodega, 18 miles north of San Francisco. We are introduced to Chloris, painter and craftsman, and to Eschscholtz, after whom von Chamisso named the California poppy, *Escholtzia californica.* Incidentally, the author pokes fun and a little scorn at the technical description of that plant.

Mr. Rogers' style of writing is vivid and rich in allusion. At times he is frankly discursive, having to snatch himself back after a page or two to his main exposition of the moment. For a few lines he may be laconic, or even adopt a clipped, almost telegraphic way of writing. Clearly he has immersed himself deeply in his subjects.

THIS is the master work of Herbert P. Whitlock, former Curator of the Morgan Gem collection. "Its 10 chapters and 179 plates, six in color, tell the story of jade for the reader who would like to know something of jade as a mineral, how it was so skillfully worked, and what the craftsman-artists who fashioned the innumerable objects from various kinds of jade intended their work to mean.
—JOSEPH HENRY JACKSON.
San Francisco Chronicle

"A magnificent book, both in appearance and content."
Long Beach Press

The Story of JADE

by Herbert P. Whitlock and Martin L. Ehrmann

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SHERIDAN HOUSE
257 Fourth Ave., New York 10

The book, which would be helped for some by the addition of an index, is illustrated by photographs, seemingly made of drawings or paintings of Menzies, Eschscholtz, and Douglas.

G. H. H. TATE.

PAGEANT OF LIFE SCIENCE

- - - - - - - by M. W. de Laubenfels

Prentice Hall, Inc., $5.95
407 pp., 1024 illusts.

IN this encyclopedic quarto-sized documented volume of 407 pages, illustrated with black-and-white drawings and halftones, the author, an authority on the sponges, tries—reasonably successfully—at an elementary level to cover the entire gamut of the biological sciences. The book, in the present edition, is divided into five major heads: general, human, plant, animal, and social biology. Each major division in turn is split into half a dozen subheads. The arrangement, therefore, is somewhat changed from the earlier edition of 1941. There are new sections in the botanical portion of the work, including a good disquisition on soil conservation by contour plowing.

It is possible to touch upon no more

Continued on page 476

◄ MT. McKINLEY at a distance of 25 miles, photographed from Wonder Lake, the stamping ground of the three prospectors who first ascended the mountain. The climbers chose the North Peak, probably because from this point the South Peak is hidden

▼ HUGE CREVASSES like this, often completely hidden by treacherous, flimsy snow, are the greatest danger encountered in this icy world, except for the sudden storms that occur high on McKinley's slopes

The Incredible Conquest of MT. McKINLEY

You think it takes thousands of dollars and years of training to climb high mountains. But a barroom challenge led to the first ascent of the highest mountain in North America—a polar expedition in three dimensions, by amateurs

By LOUIS R. HUBER

Photographs by BRADFORD WASHBURN

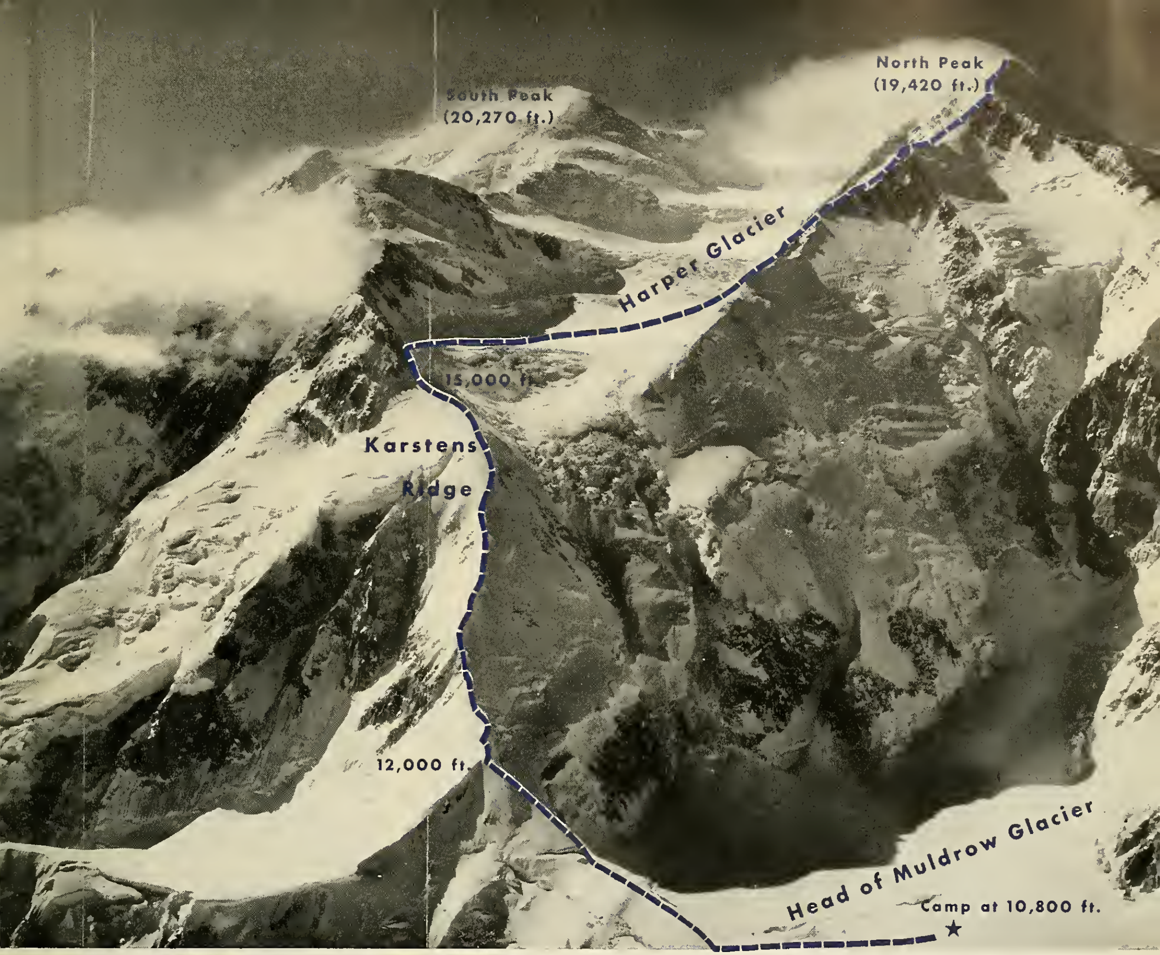
BILLY McPHEE, rotund Fairbanks saloonkeeper, brought his fist down on the mahogany bar, causing the glassware to jingle.

"I got five hun'erd dollars in gold dust in that till over there. Every grain of it says Alaskans are gonna be first to reach the top of Mt. McKinley. If that ain't enough for an outfit an' some grub, I got more. Now, who'll climb the mountain?"

This was the prologue, early in 1910, to the first successful ascent of North America's highest mountain. Six sourdoughs took up McPhee's challenge; two of them got to the top of the mountain, and a third almost made it. Though they were strictly novices in mountaineering, no one has ever equaled them for sheer guts and hardiness. They "took it easy" up to 11,000 feet. There they proceeded to build a 4000-foot stairway and then surged right on to the top. When they got back, nobody would believe them, until . . . but we mustn't get ahead of the story.

The history of our highest mountain is as short as its peak is high. In 1889 Frank Densmore, a prospector, went into the Cook Inlet country of Alaska. He came back without much gold, but he had an amazing tale about a high mountain, which soon became known in the Yukon Valley as "Densmore's Peak." His fellow gold seekers didn't know the Indians had called this mountain "Denali" for ages nor that the Russians, occupying Alaska until 1867, had called it "Bolshaia"—both terms meaning "The Great One." In 1896 a second prospector, W. A. Dickey, wandered past and named the peak all over again. Obviously a staunch Republican, he called it "Mt. McKinley," in honor of the presidential candidate. This name stuck, much to the chagrin of apostles of aboriginal nomenclature. They insisted that "Denali" was the rightful name—just as they maintain that "Tacoma" is correct for 14,408-foot Mt. Rainier, near Seattle.

At this time nobody had much idea how high Mt. McKinley was. In 1897, the Duke of the Abruzzi came over from Italy with a large



▲ An aerial view of Mt. McKinley taken from an altitude of 15,000 feet, showing the exact route followed by the prospectors in 191

History of Mt. McKinley

(Originally called Denali by the Indians)

1889	Frank Densmore reported and described the mountain, and it came to be called Densmore's Mountain.
1896	W. A. Dickey named it Mt. McKinley after the Republican presidential candidate.
1897	The Duke of Abruzzi climbed 18,008-foot Mt. St. Elias, 375 miles to the southeast, thinking it to be the highest peak in North America.
1900	The U. S. Geological Survey measured Mt. McKinley (20,270 ft.).
1903	First attempt to climb Mt. McKinley made by Judge Wickersham of Fairbanks.
1903	Second attempt (from the northwest) made by Dr. Frederick A. Cook.
1906	Dr. Frederick A. Cook claimed to have climbed it (from the southeast).
1910	The sourdoughs made their famous ascent of the North Peak.
1910	The Parker-Browne expedition assaulted the south face of the South Peak unsuccessfully.
1912	The Parker-Browne expedition reached a point only 150 feet below the summit of the South Peak but were driven back by a tremendous storm.
1913	Archdeacon Stuck's party (four men) made the first ascent of the South Peak, on June 6.
1932	South Peak ascended by Lindley-Leik expedition (four men).
1932	North Peak ascended by Lindley-Leik expedition (four men).
1942	South Peak ascended in July by U. S. Army Alaskan Test Expedition (seven men).
1947	South Peak ascended in June by Boston Museum of Science expedition (eight persons; first ascent by a woman, Barbara Washburn).
1947	North Peak ascended in June by Boston Museum of Science expedition (six men; first ascent by a woman).
1947	South Peak ascended in July by three University of Alaska students.
1948	South Peak ascended in July by three University of Alaska students.

retinue of Alpine guides and porters and climbed 18,008-foot Mount St. Elias on the coast, never dreaming that a mountain more than 2000 feet higher lay 375 miles to the northwest. About 1900, the United States Geological Survey came along and measured Mt. McKinley—and the race was on. Here, indeed, was the highest point in North America. But that was not all: McKinley was the highest mountain mass in the world rising out of a lowland plain; 14,500 feet of it is in a single precipice, while the highest cliff on Mt. Everest is about 9000 feet.

The sky-sweeping heights of the Himalayas and the Andes are higher than McKinley (29,000 and 22,800 compared with 20,270 feet) but those mountains rise from lofty plateaus that are 10,000 to 15,000 feet high. Mt. McKinley sits on a tableland that is only 2000 feet above sea level. It soars up to the sky in a gigantic, unbroken sweep—almost four miles of rock and ice from base to peak. Nowhere else on earth does a mountain rise in such majesty.

What a challenge to mountaineers, who must here overcome not only height but arctic conditions as well! Mt. McKinley is probably the coldest mountain in the world. To scale it is a sort of polar expedition in three dimensions. Most of the world's high peaks are within 40 degrees of the equator, where snow and ice melt from their lower reaches. On 20,577-foot Chimborazo, in the equatorial Andes, which almost duplicates McKinley's height, firewood is found at 14,000 feet. Even in the 29,000-foot Himalayas, the level of perpetual snow lies at 17,000 feet. But Mt. McKinley lies only three degrees south of the Arctic Circle, and snow is always found on its lower levels.

The greater the perils, however, the greater the challenge—and as soon as McKinley's pre-eminence became known, mountaineers began arriving. Several parties failed over a period of years; then, in 1906, Dr. Frederick A. Cook claimed success. He wrote a book about it, *To the Top of the Continent*, and immediately was famous. He lost no time undertaking even greater adventures: Within three years he claimed he had reached the North Pole. When in 1909 Admiral Robert E. Peary won lasting fame as the true discoverer of the North Pole, it became clear that Dr. Cook had been bamboozling the public. This was the news that aroused indignation in the sourdoughs and impelled them to try climbing Mt. McKinley themselves.

These would-be Alpinists, of course, didn't know the first thing about mountaineering. Prospectors shun mountains, as a rule: the higher they find gold, the more work it is to carry machinery up the mountain to mine it, and the harder it is to get the ore down. Snows force closure of high mines too early in the fall and keep them closed too far into the spring. But since they were going up Mt. McKinley for glory and not for gold, the sourdoughs' confidence was unbounded.

They set off lightheartedly. By

◀ AN IMPRESSIVE SCENE on the route followed by the sourdoughs. Here Muldrow Glacier flows through a gorge with a 3000-foot cliff on one side and a 5000-foot cliff on the other—almost as deep as the Grand Canyon. Dog teams and mountaineering equipment were not used by the sourdoughs; they carried only a shovel and left no pictorial record of their expedition the time they came to the foot of the mountain, however, they disagreed over something and had a fist fight. Three of them stalked back to Fairbanks in a huff. The three that were left didn't have proper equipment—not even a rope, generally indispensable to any reputable mountaineer.

Not one of the sourdoughs could have told you that an *arête* is a ridge, a *couloir* a gully, or that *crampons* are climbing irons. So they just climbed on their nerves. Two things they did have: pluck and luck. Also they carried a fourteen-foot pole and an American flag, to be erected on the summit—they hoped. They had no particular idea which route to take; no climber except Dr. Cook had claimed he had found a feasible approach. The sourdoughs took a guess and began plodding their way up Muldrow Glacier—which later proved to be the only practical route.

No one can say how long it took them to climb this icy roadway: they took no notes, and they never wrote a book. They just climbed. At length we find them at the head of the glacier, at 10,800 feet, where they paused to rest and to study the nearly vertical ice fields above them. Our adventurers were Pete Anderson, Billy Taylor, and Charlie McGonagall—rough, sturdy miners who didn't back down from a dare.

Having reached this height, the three men proceeded in their ignorance to flout another of the basic rules of mountaineering: they did not establish base camps at progressively higher levels, with shelters and food caches, to which, if blizzards should come, they could retreat for safety. They didn't have enough equipment to set up depots. Yet 9000 feet of the mountain had yet to be climbed. Their route was now obvious: up the great icy spine known today as Karstens Ridge. They investigated this ridge several times before attempting the final scramble. When blizzards closed in on them, they just waited and hoped their food would last. But when good weather allowed, they hacked and shoveled a staircase right up the 4000-foot ridge.

When dawn came clear on the morning of April 10, they had little more than a good-sized picnic lunch left. What of it—wasn't that enough for the rest of the trip? They started up, on the last 9000 feet of the mountain.

The ridge led them to a large snow basin later named Harper Glacier. At that point they had to make a choice—and here, for once, they went wrong. They could see the summit, and it consisted not of one, but of two peaks. One was the

▲ A MODERN PHOTOGRAPH taken near McGonagall Pass (5650 feet) and right on the sourdough trail up McKinley

➤ THE THREE PROSPECTORS in 1910 must have passed right near here, at an altitude of 6000 feet south, or true, summit—20,270 feet high. The other was the north, or false, summit — 19,420 feet high. From where they stood, the sourdoughs could not tell which peak was higher.

But the north peak was closer to Fairbanks; and it was the only peak that could be seen from Kantishna and Wonder Lake, only 25 miles away, where these prospectors and their partners had been looking for gold. They ardently hoped that a good spyglass down there would pick up the three tiny human specks inching their way toward the top. So they chose the north peak, and their vanity cost them undying fame. How were they to know that, among mountaineers, even a few inches at the top of a mountain can mean the difference between success and failure, glory and oblivion? At any rate, up they went.

When they had climbed to 19,000 feet, McGonagall had had enough. He had hauled the heavy flagpole all the way up to that point, and the icy wind whipping around the ridge had numbed him. He had a headache from lack of oxygen; he was plumb tuckered out.

"Go on up," he told the others. "I'll wait for you down at the snow basin." Today McGonagall is the only one of the three remaining alive. He is still an active man and can be seen hard at work outdoors around Fairbanks.

Anderson and Taylor struggled up the fearful slope. The sun grew just warm enough to keep the frigid wind from freezing them. They didn't stop until they reached the top.

Anderson tied the flag to the pole they still carried, while Taylor hacked a hole in the ice. Then they planted the butt end of the pole in the hole and stomped ice and drifted snow into a pyramid around it. This done, they took a good look at the incomparable view stretching off around them in all directions for hundreds of miles.

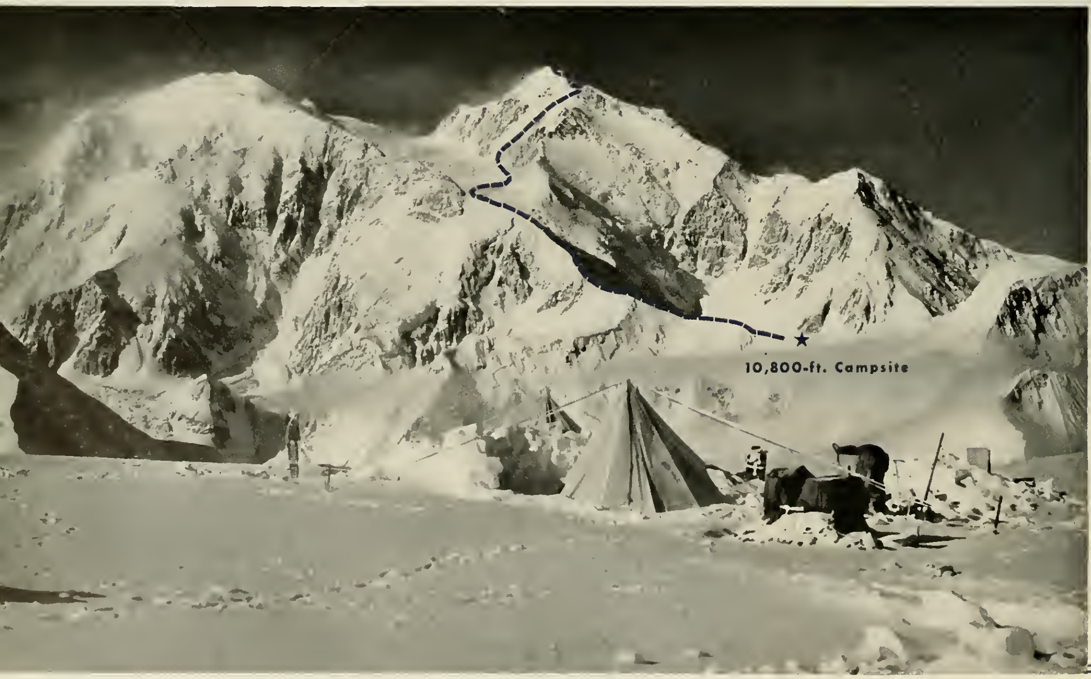
The nearest and most impressive sight was, of course, the snow cone of the south peak, two miles away across the deep valley of Harper Glacier. Second most impressive was the incredible plunge, right at their feet, down the 14,500-foot snow and ice wall of the north face to Peter's Glacier. Beautiful Foraker ("Denali's Wife" to the Indians) towered twelve miles away to the west, floating like a silvery island in a sea of clouds. Far to the southwest lay the broad valley of the Chulitna River, favorite dogteam route of prospectors mushing from Cook Inlet to the interior. To the north and west lay the broad, flat plain where the Kuskokwim River has its source.

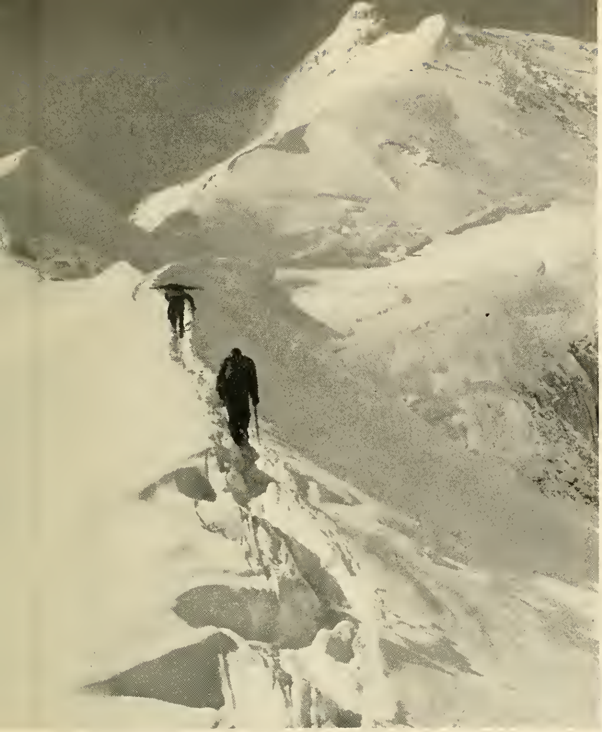
They looked especially hard to the northeast — toward Fairbanks, 160 miles away. And toward Kantishna and Wonder Lake they waved their arms in salute to their partners, even though their gestures would not have been visible through the telescopes available in that day.

Then they started down.

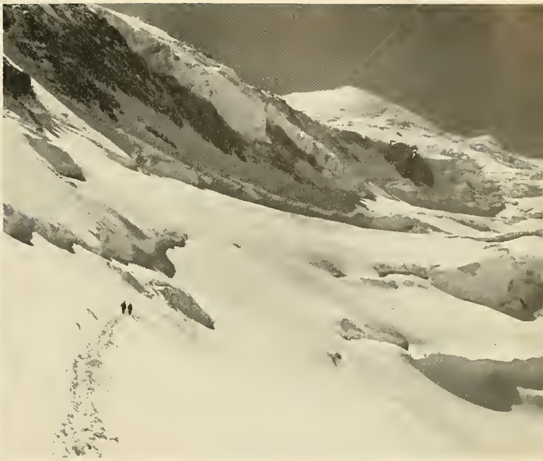
They overtook McGonagall and covered the full 9000 feet they had climbed that day, down to the head

∀ FROM THE CAMPSITE marked on this photograph at 10,800 feet, the sourdoughs planned their final assault on the world's coldest mountain. The South Peak is seen at left, the North Peak at right





▲ KARSTENS RIDGE, the wind-swept knife edge of snow up which the prospectors cut a 4000-foot stairway toward success. But convincing the world of their achievement proved more difficult than the ascent itself



▲ THE CLIMBERS CIRCLED this steep slope at about 14,600 feet to reach the first plateau of Harper Glacier. South Peak, more than 5000 feet higher, is seen in the center

▲ THIS LONELY SCENE must have been exactly re-enacted in 1910. Just above here, the sourdoughs tackled the great 3000-foot ice and snow gully that leads to the North Peak (behind camera)

of Muldrow Glacier. In less than 24 hours they had, without even realizing it, surpassed all records for a day's climb at such high altitude.

Exceptionally good weather had made their feat possible; to that they owed not only success but, undoubtedly, their lives as well. Experienced mountaineers still exclaim over the sourdoughs' accomplishment with amazement and respect.

The three climbers returned to Fairbanks and told the patrons of Billy McPhee's saloon—drinks on the house—all about their trip. They told about it again and again—and there was one question people always asked, in the end:

"Did you *really* get to the top?"

Anderson, Taylor, and McGonagall got very tired of it. When they realized that even their friends didn't really believe that they had upheld Alaska's honor after all, they were bitter.

"Hell, yes, we got to the top," they would answer, when the inevitable question came. "We got there, all right—and if you don't believe it, climb up and take a look. We stuck a flagpole in the top of it."

The assault upon Mt. McKinley continued; indeed, even as the sourdoughs were reaching the top, there was another expedition on the other side of the peak, searching in the wrong place for a route upward. It never got above 10,000 feet, about halfway. In 1912 this same expedition returned and, following the route of the sourdoughs, got to within a few hundred feet of the top when a blizzard drove them back.

In 1913, two Alaskans led an expedition that succeeded at last in reaching the summit of the south—and highest—peak. They were the Reverend Hudson Stuck, a mountaineer of experience and Episcopal archdeacon of the Yukon Valley; and Harry Karstens, a sturdy sourdough. With them were R. G. Tatum, another sourdough; Walter Harper, a robust half-breed Alaskan Indian; and Johnny Brown, an Indian from Stuck's Nenana mission, who tended the dogs at the base camp. This expedition had a terrible time climbing most of Muldrow Glacier and Karstens Ridge. This route had been relatively easy three years before, but the great earthquake of 1912—as though to immortalize the glory of the sourdoughs—had disrupted it fantastically. Archdeacon Stuck's party climbed under the greatest technical difficulties ever experienced by any group before or since. But all the way, as might be expected, they took occasion to discuss the question of whether the sourdoughs had really reached the top.

It was probably Walter Harper whose sharp eyes first saw the pole.

"There it is!" he cried. "It's still standing there!"

Out came binoculars, and they scanned the peak. Sure enough, there was the pole! Wind had long since shredded and scattered the American flag; but the fourteen-foot pole was still erect, sharp against the blue—"plain, prominent, and unmistakable," Stuck later wrote.

The sourdoughs had really got to the top, even if it had been the false summit, 300 feet short of the goal.

The Stuck-Karstens climbers continued to have good weather and reached the south peak; and Alaskans thus were victorious in the long struggle to set foot on the top of the continent. Since then a number of climbers have conquered the mountain, but it has also taken its toll in human life. Greatest dangers, perhaps, are the deep crevasses in the glaciers, hidden under a treacherous covering of snow. It was one of these crevasses that cost the lives of Allen Carpé and Theodore Koven in 1932. The National Park Service, in whose domain the mighty mountain lies, does not want to have to rescue foolish adventurers from its hostile slopes. Only well-equipped and capable expeditions will be given permission to explore the dangerous sections.

Even with the best modern equipment, McKinley is no cinch. The sourdoughs of 1910 did it the hard way. On their side was their knowledge of snow and ice and of sub-zero camping—indispensable assets. But the feat was physically tremendous, and there were a multitude of hidden and unpredictable dangers. We must always admire them for their audacity, determination, and sheer grit.

⮟ THE VIEW SEEN BY THE VICTORIOUS PROSPECTORS from the summit of North Peak, looking northeast down the crest of Muldrow Glacier. It was three years before their attainment of the summit was verified by Archdeacon Stuck and his companions. This photograph, the only one in existence of this view, was taken in 1947

DESERT FISHES—

Clues to Vanished Lakes and Streams

How the mapping of present-day fish distribution in American deserts gives unmistakable evidence of now vanished drainage systems

By ROBERT R. MILLER
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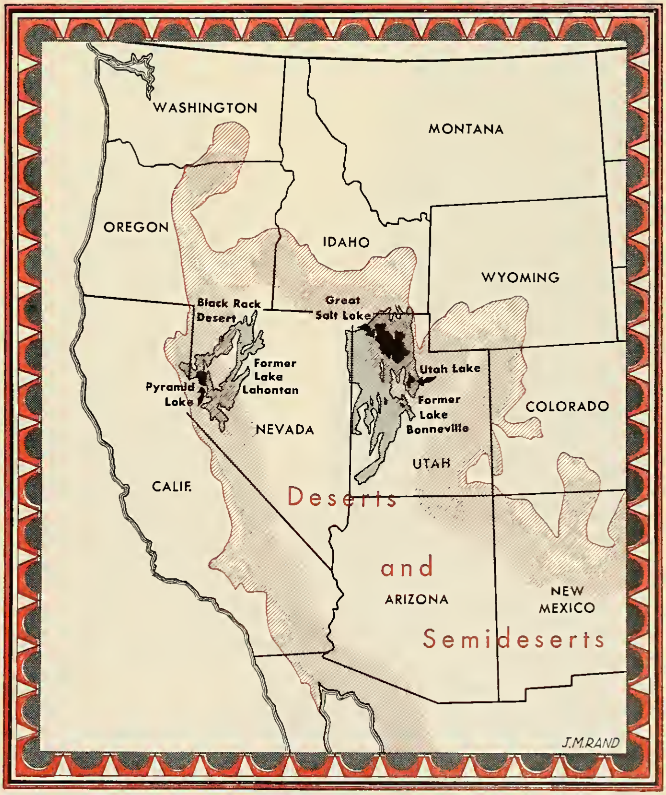
Photographs by the author unless otherwise credited

ONE spring day in 1936, I set out on one of the first of many strange and fascinating fishing trips. My route took me not to mountains, valley, or seashore but to the very heart of the Mohave Desert, an arid expanse of nearly waterless country lying along the eastern border of California. I tried to convince my friends that I was not seeking fossils but expected to catch living fishes in the desert. One can hardly blame them for thinking that such an unorthodox venture was slightly mad. Yet today we know that even in Death Valley, the hottest region in the Western Hemisphere and (with the possible exception of the Atacama Desert in Chile) the driest one, small, brightly-colored fishes dart about in the briny waters of Salt Creek, 250 feet below sea level.

The popular belief that deserts are barren wastes, devoid of most forms of life, is a natural conclusion after observing these regions from a speeding car or train window. Mile after monotonous mile of sun-baked, nearly treeless plain stretches endlessly into the distance, and the only desire of most travelers is to cross it as quickly as possible. Such casual observers are therefore much surprised to learn that deserts support abundant populations of small animals, particularly rodents and lizards, and that these are sometimes more numerous in this inhospitable land than they are in areas of comparable size in well-watered, humid regions. They are even more amazed to discover that fish life is a characteristic and highly significant element of desert faunas.

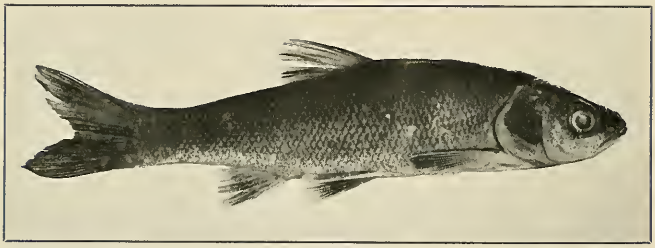
The Hollywood version of a desert—a vast expanse of shifting sand dunes—falls far short of the actual physical make-up of most deserts. Even the Sahara, most famous of sandy deserts, is only about one-tenth sand. A desert is characterized chiefly by high summer temperatures, scarce and irregular rainfall, low humidity, and generally a high average wind velocity. There is usually a rather meager but very interesting and highly specialized flora. Deserts are regions of great extremes. For example, at Bagdad, on the central



➤ 10,000 TO 30,000 YEARS AGO, climatic conditions permitted the formation of valley glaciers in regions that are now desert. Lake Lahontan and Lake Bonneville then covered parts shown here. Today only small vestiges remain

▲ EVEN DEATH VALLEY, the driest place in North America, has its floods: the Amargosa on the loose

Photo by Clarence Flaten



▲ WHEN a fish of this type is found in springs or creeks, there is reason to believe that the region formerly contained a fairly large body of water. *Siphaletes obesus pectinifer,* a fish adapted to lake life

"THE DESERT INN"→1933←
Pyramid Lake, Ne
WOR''S LARGEST TROUT

▲ FISHES are the last thing the average person expects to find in the desert. But the largest western trout ever caught was hooked here—a 41-pound cutthroat. The largest fish in this picture weighs 12 pounds

Mohave Desert, there is a record of three consecutive years without a trace of rain! Heavy downpours occur sporadically in small areas, however, and such cloudbursts may bring as much rain in a few minutes as would normally fall in an entire year.

The world's record for daily change in temperature is held by the desert— 26 degrees F. to 126 degrees F. in 24 hours in the Sahara. The highest known shade temperatures are also held by deserts— 134.1 degrees F. in Death Valley and 136.4 degrees F. at Azizia, south of Tripoli. The extreme dryness and the remarkable clearness of the air contribute to the great daily fluctuations in temperature. Dust-free air produces amazing deceptions of distance, and since there is usually nothing in the bare landscape to give scale, the desert explorer quickly learns to have great respect for distances.

Scarcity of permanent water is an outstanding feature of deserts everywhere. In the early days of exploration, particularly during the gold rush stampede of 1849, the desert took frequent toll of the lives of man and beast, and it even does so sometimes today, although the dangers are now comparatively insignificant. The uninitiated must beware of camping in any innocent-looking dry wash, for cloudbursts in mountains 50 miles distant often bring disaster. Damage by floods, strange as it may seem, is a characteristic occurrence in deserts.

The desert regions in western United States vary from the extreme aridity of Death Valley, with an average annual rainfall of slightly more than one inch, to the less torrid, elevated valleys of the Great Basin. Our American deserts include nearly all of Nevada, Arizona, Utah, and New Mexico, southeastern Oregon, southern Idaho, eastern and southeastern California, and parts of Washington, Wyoming, Colorado, and Texas. In all of this thirsty region, irrigation farming is a necessity, for the annual average rainfall is only about ten to twelve inches. The Great Basin, which includes most of the area lying between the Sierra Nevada of California and the Wasatch Mountains of Utah, receives its name from the fact that its streams disappear into sinks, from which their waters evaporate, or they flow into lakes without outlet to the sea. It is a region of interior drainage—hence the allusion to a basin.

Over 100 years ago, when Fremont first explored the region, the "basin" was believed to be completely rimmed by mountains. It was soon discovered, however, that the Great Basin really consists of a series of parallel valleys, usually with independent drainage, separated by steep mountain ranges extending generally in a north and south direction. It is the present-day distribution of the fishes of these isolated valleys that provides a key to the past history of the waters of this arid expanse.

The desert regions of the West support nearly half of the known kinds of fresh-water fishes native to western North America north of Mexico. Some of them are as unique in the fish world as the remarkable saguaro, or giant cactus, is in the plant world.

Blind fishes, underground rivers, and bottomless springs are favorite topics among desert folk. These popular desert myths are often foisted upon the unwary "city tenderfoot," but they are also an attempt to explain how living fishes came to inhabit the desert. No authentic blind fishes have been discovered in the fresh waters of western North America. Should anyone have reliable information as to the occurrence of such fish, the author would greatly appreciate receiving this information. But how did fishes of any sort get there? That is the question repeatedly asked but rarely answered. The story of how the old Indian squaw fell into a bottomless spring in Nevada and reappeared in Death Valley is part of the lore of the desert. But don't believe anyone who tells you that this is the way the present fishes of the desert reached their isolated springs! We must study events of the great Ice Age if we are to discover the true explanation.

These creatures crossed the now parched sands separating the iso-

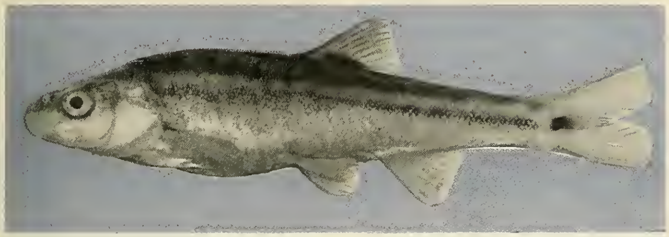
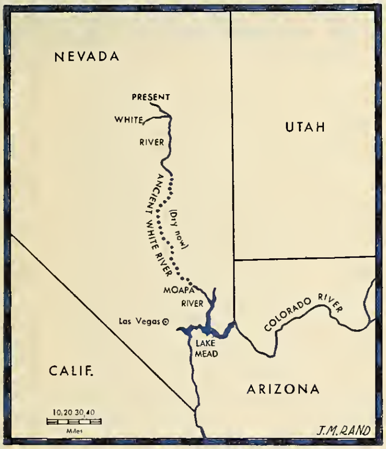


Photo by Clarence Flaten

▲ One of the old assemblage of fishes that inhabited the White River drainage basin: *Moapa coriacea*, which now lives only in the Moapa River, which drains into the north arm of Lake Mead



▲ About 20,000 years ago, the White River flowed through southeastern Nevada to join the Colorado River. Today it dies in the desert far to the north

➤ Arrowhead Canyon, through which the White River of Nevada formerly flowed—now a dry gorge. It once served as a thoroughfare for fishes that today are restricted to scattered water holes

➤ A FISH that can live in water over 100 degrees F.: *Eremichthys acros,* known only from a few hot springs and creeks along the edge of Nevada's bleak Black Rock Desert

Photo by Clarence Flaten

▼ SARATOGA SPRINGS in Death Valley, home of fish that have survived in the desert since the Ice Age

▼ A REMARKABLE FISH only an inch long that lives in a pool 50 feet below the surface of the land, near the eastern edge of Death Valley. Practically all the individuals of this species in the world can be viewed at one time

Photo by Clarence Flaten

lated springs and creeks when the desert was a well-watered land. They did not arrive as eggs on the feet of aquatic birds traveling from one isolated water hole to another. Such an occurrence might possibly take place occasionally in humid lowland regions. But it takes more than the safe transfer of a single egg, or a dozen eggs, to establish a species. I have repeatedly attempted to establish desert spring fishes in natural waters by transferring hundreds of individuals, but I have so far met with almost complete failure. What chance would a few eggs have of surviving dehydration during even a short flight in the dry desert air? Furthermore, if such a means of transfer were effective, we would not expect to find the regular patterns of distribution that we see today.

Ancient shore lines, which you may have noticed cutting dramatically across the mountainsides in Utah and Nevada, look as real as though the waters that formed them had vanished only yesterday. The evidence for the former existence of these lakes is as convincing as the evidence for the Ice Age, and geologists believe that the two phenomena happened almost at the same time. The present distribution of desert fishes is in harmony with and often augments the conclusions of geologists about these ancient lakes and streams. As shown on the accompanying map, some of these inland seas, such as Lake Bonneville in Utah and Lake Lahontan in Nevada, rivaled our present Great Lakes in size and depth. Geologists believe that these lakes existed during the last great advance of the continental glaciers of eastern North America, when the climate of the Great Basin was cool enough to permit the formation of valley glaciers and to allow precipitation to exceed evaporation. This may have taken place some 10,000 to 30,000 years ago. With the shrinking of the glaciers, the ancient waters gradually contracted until all that now remain of Lake Bonneville and Lake Lahontan are a few remnant lakes such as Great Salt Lake, Utah Lake, and Pyramid Lake. In many other basins nothing is left but so-called "dry lakes" or playas, which may occasionally hold water for a short period after floods. These are the regions where perfect mirages are encountered, and the traveler often cannot say with certainty whether the lake bed is wet or dry until his car actually crosses the playa.

With the drying up of these Ice Age lakes, the fish fauna became segregated as one valley after another was isolated by the receding waters. The relationships of the now separated springs and creeks is, however, readily determined by a study of the remnant fish life. This is possible because the fishes inhabiting the ancient drainage systems, such as those of Lake Bonneville and Lake Lahontan, are distinctive for each basin. Thus, for example, in sampling the fish life of a disconnected creek along the border of Nevada and Utah, an ichthyologist found Bonneville types and predicted a former Bonneville connection before he knew where the stream in question drained. He then traced the stream bed down, and it soon dipped below the great terraces of Lake Bonneville, thus confirming what his sample had already told him. When the ichthyologist discovers closely related fishes in a chain of isolated springs or creeks, he knows that these now separated waters are remnants of a former integrated drainage; and when he finds only dissimilar fishes in closely adjoining basins, he has evidence that the waters of these basins have not been connected within recent geological times.

Hand in hand with the disrupted physiography of the Great Basin, consisting as it does of dozens of isolated valleys, the fishes are found to fall into more or less unrelated groups. The larger of the separate drainage basins, such as those formerly occupied by Lake Bonneville, Lake Lahontan, and the Death Valley system, show a fairly rich variety of fishes. But most of the smaller isolated basins contain only one to three species, if any. Some of the characteristic types of fishes that inhabit these desert regions are illustrated in the accompanying photographs. The chubs belonging to the genus *Siphateles* are widespread in creeks and springs of the Great Basin and live under a wide variety of physical and chemical conditions. The kind shown in the photograph is of a type that inhabits lakes, to which it is well suited because its oblique mouth is adapted for surface feeding and because its numerous gill rakers serve as a sieve for straining the abundant minute organisms (plankton) from the water. When we find a fish of this type in a river or spring, we may logically suspect that a large lake or lakes formerly existed in the area, and often at no very remote time.

Mummified fish remains buried by early Indians help us to reconstruct the landscape upon which these aborigines gazed. Thus, studies of mummified *Siphateles* excavated from Humboldt Cave, Nevada, tell us that when the ancient Indian culture flourished, the adjacent Humboldt Lake, now an alkaline flat, was a permanent body of fresh water.

Another minnow, *Eremichthys acros,* is known only from a few hot springs and creeks along the edge of Nevada's bleak Black Rock Desert, one of the most desolate regions in the West. This fish enjoys the distinction of tolerating one of the highest water temperatures of all the known North American minnows*—over 100 degrees F. *Eremichthys,* meaning "desert fish," is presumably a living remnant that antedates even ancient Lake Lahontan.

Approximately 20,000 years ago the White River of southeastern Nevada, whose waters are now absorbed by the thirsty desert, was a tributary of the Colorado River. As long ago as 1891 an ichthyologist, Charles H. Gilbert, came to this conclusion, for he found fish in this now isolated drainage belonging to a kind previously known only from the Colorado basin. It was not until 22 years later that his logical deduction was fully substantiated, independently, by a geologist who traced the dry channel of the old river all the way to the Colorado. The imposing gorge through which the waters of the Ice Age White River flowed on their way to the Colorado is pictured on page 449. It now lies in the midst of one of the most parched areas in Nevada, standing as mute testimony, supported by the distribution of the White River fish fauna, for the former continuity of the ancient river.

One of the several distinctive fishes of this old fauna is *Moapa,* which now lives only in Moapa River, a tributary to the north arm of Lake Mead from the Nevada side. Like *Eremichthys, Moapa* is a survivor of greatly restricted distribution, for it is known to occur only in the Moapa hot springs and the warm portions of their outflows, in temperatures varying from 87 degrees to 90 degrees F. Moapa River is the terminal flow of the old White River, which had its source about 175 miles to the north in the White Pine Range west of Ely, Nevada.

Turning to the family of killifishes, we find a number of unique types inhabiting the springs and creeks of the Death Valley system. This system once formed a continuous drainage from Owens Valley, at the eastern foot of the Sierra Nevada, to Pahrump Valley, which lies along the Nevada-California boundary east of Death Valley.

A remarkable dwarfed species, *Cyprinodon diabolis,* inhabits an equally remarkable spring hole in Ash Meadows, near the Nevada border. Devil's Hole, as this unusual spring is appropriately named, lies about 50 feet below the land surface and appears to represent a water-formed cave, the roof of which has collapsed. The descent into the hole is a sheer drop on all but the western side, where one can scramble down the walls of a narrow, rocky crevasse. The clear pool of deep blue water is without apparent inlet or outlet, and its depth is unknown. It has a constant temperature of 93 degrees F. Nearly the entire population of this species, which attains adult size at a length of less than an inch, inhabits a rocky ledge, approximately eighteen feet long and a few inches to two feet deep, at one end of the pool.

Since all of the individuals of this odd little fish may be seen at one time, a very close estimate of the total population is possible. In December, 1938, I estimated that there were only 50 to 75 individuals, but in July, 1938, at least 400 fish were present. The unusually small total population of this species has evidently been a potent

Continued on page 475

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* The terms minnow, chub, shiner, dace, all refer to fishes of the minnow family, Cyprinidae. They should not be confused with the common names of top minnow, desert minnow, or desert sardine, which have been used for members of the killifish family, Cyprinodontidae, a group only distantly related to the Cyprinidae.

Evening Star

By Robert R. Coles

Associate Curator, Hayden Planetarium, American Museum of Natural History

A GEM of resplendent beauty will shine in the western evening skies this December to thrill observers all over the world. On Christmas Eve it will glow in the twilight like a symbol of the Star of Bethlehem that shone nearly 2000 years ago. Indeed, it is entirely possible that this is the very same "star" that guided the Wise Men to the manger at the time of that first Christmas. Many earthbound observers will suppose that this light marks the top of some new beacon tower erected to guide aircraft. Flyers will depend upon the formula of its movements to determine their latitude and longitude. Thousands will contact observatories and planetariums to ask about it. Some will even view it with mixed feelings of wonder and fear until they are assured that it is harmless.

Public reaction to such phenomena is always interesting. It often runs the gamut from intelligent curiosity, through superstitious wonder, to fear and panic. But once people become acquainted with the true explanation, these things take on an added interest that sometimes opens the way to a new world of enjoyment. History reveals that many of our greatest astronomers were inspired to begin their careers by some similar sight in the heavens. While we cannot predict that this sight of Venus will bring to light any future George Ellery Hales or Harlow Shapleys, it will most certainly set many thousands to thinking about the wonders of the universe, and we hope that some of these may accept the challenge to become better acquainted with our neighbor worlds.

Venus appears as the brightest object in the heavens, with the exception of the sun, moon, and an occasional comet. Being one of the two planets that circle the sun inside the earth's orbit, it behaves differently from Mars, Jupiter, or Saturn, which move on orbits outside that of the earth. Like Mercury, the other planet that is nearer the sun than we are, it shuttles back and forth from the morning to the evening sky but is never seen in the midnight sky.

There will be no possibility of mistaking Venus this December when it blazes forth high above the southwestern horizon, against the background of stars in the constellation of Capricornus, the Sea Goat. It will dwarf every star in that part of the sky, its nearest rival being the planet Jupiter, which will appear near by but less brilliant. Early in the month the two planets will appear relatively near together, and on December 6, Jupiter will lie directly north of Venus by a distance of about four times the apparent diameter of the full moon. On the evening of December 22, the beautiful crescent moon will be seen near by and a short distance to the south of Venus. The next evening the moon will have shifted about thirteen degrees farther east and will continue to separate farther

The Christmas season this year brings an unusual opportunity to view the brightest planet in the heavens

from the planet each night as it grows toward its first quarter phase.

Like so many sky wonders, this one can be enjoyed for only a short time. Venus will attain its greatest brilliance on December 26, and during the remainder of the year and the early weeks of 1950, it will rapidly disappear in the evening twilight. On January 31, it will move into the morning sky and for a few weeks be lost in the dawn. After about a month, however, early risers may find it shining above the eastern horizon as a beautiful "morning star." We will not see it again as an "evening star" until the spring and summer of 1951.

This planet is one of the most interesting and mysterious members of the solar system. It sometimes approaches within about 26 million miles of the earth, which is closer than any of the other major planets ever come. When you see it in the Christmas sky it will be about 39 million miles away—nearer than Mercury can ever come and closer than Mars will be for several years.

Due to its brilliance, this planet has attracted attention since before the dawn of history. When they saw it in the morning sky, the ancient Greeks called it Phosphorus. But they knew it as Hesperus in the evening sky. Few if any then recognized that they were viewing the same planet in different parts of its orbit.

Through the years astronomers have learned not only how it moves in its orbit but also much about its physical characteristics. At the same time, Venus, like the clever lady that she is, has been eminently successful in keeping the star doctors guessing about many secrets.

In 1610 Galileo Galilei, professor of mathematics at the University of Padua, studied Venus through his telescope and discovered, for the first time, that it went through phases like the moon. But he also observed that its apparent diameter changed with the various phases, which was different from the way the moon behaved. When Venus appeared at the new phase (like a new moon), its diameter was about six times as great as it appeared when near the full phase. This proved that it was sometimes closer to us, sometimes farther away. It also proved that its path around the sun lies completely inside the earth's. Otherwise, it would appear largest at the full phase—in other words when the earth lay between the sun and Venus. It was the first actual proof of the famous theory of Copernicus, that all the planets revolve around the sun. Since Galileo's time the orbital motion of Venus has been determined so well that astronomers can predict its future positions with a very high degree of accuracy.

Having a diameter of about 7580 miles, which is only slightly less than that of the earth, it has been called our twin planet. But, as we shall see presently, the likeness ends with the similarity in size.

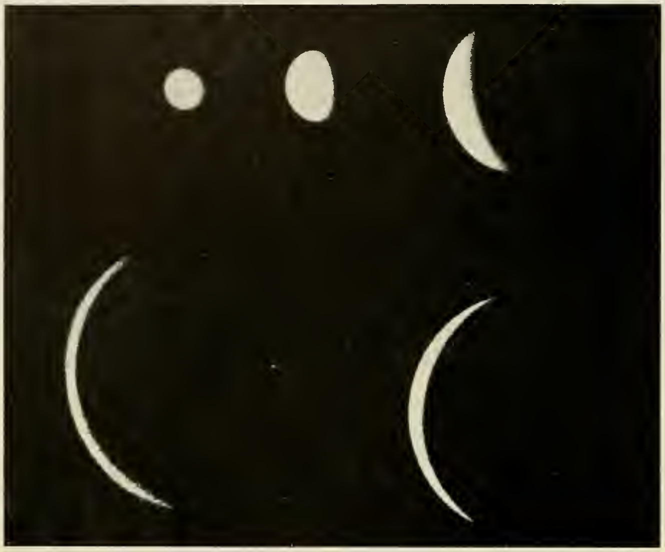
Since Venus approaches nearer than any of the other planets and is so conspicuous in our skies, we might presume that the astronomers would know more about it than the others. Unfortunately, however, this is not so. Amazing as it seems, man has never looked upon the surface of Venus. Even his most powerful telescopes and sensitive photographic equipment cannot penetrate far into its dense atmosphere. But despite their failure to see the surface, our astronomers have made several interesting discoveries concerning the nature of its atmosphere, and from these they have surmised what it may be like beneath the clouds.

Not only is the atmosphere very dense but it extends for several miles beyond the surface of Venus, so that by direct observation we can only study its upper levels. Spectroscopic studies conducted at Mount Wilson reveal that this upper atmosphere contains little if any free oxygen and practically no water vapor, both of which are essential to the support of life as we know it on the earth.

Investigations by Pettit and Nicholson have indicated that the temperature on the sunlit side of Venus is between 120 degrees F. and 140 degrees F., while on the darkened side it is around –9 degrees F. We know that there is little water vapor in the higher levels of our atmosphere, and temperatures in the stratosphere are considerably lower than those indicated in the upper atmosphere of Venus. This might suggest that conditions on the surface of Venus would be more favorable for life than at first seems possible. But further investigations disprove this theory.

Spectroscopic studies, conducted

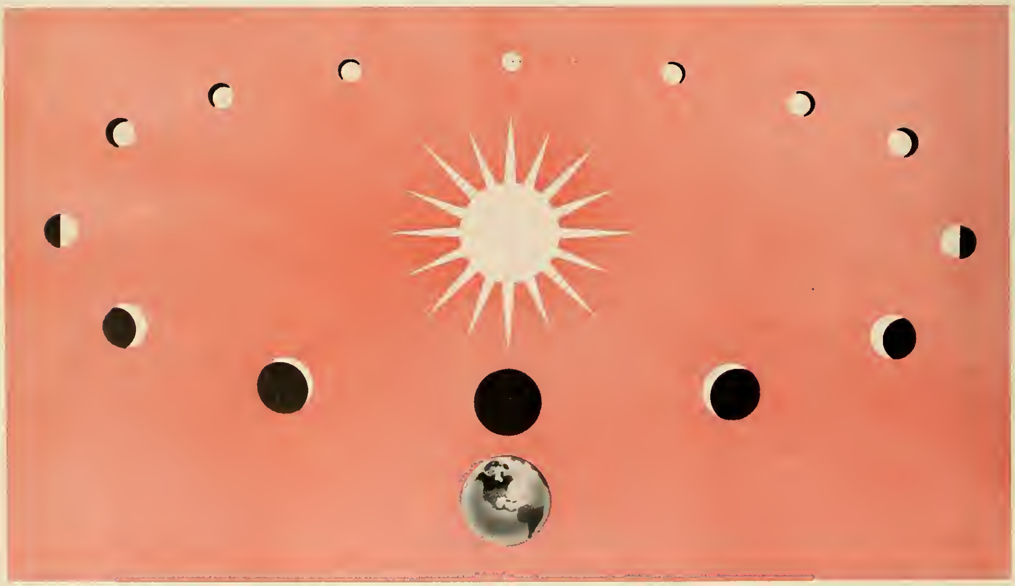
Photo by Lowell Observatory



▲ TO THE UNAIDED EYE, Venus seems to vary greatly in brightness. The telescope reveals that it actually appears six times as large at some times than at others. But it also goes through phases like the moon, as indicated here

▼ BECAUSE VENUS appears largest when it is in the crescent phase, Galileo deduced that its orbit must lie completely within the earth's path around the sun

Drawing by Museum Illustrators Corps



by Adams and Dunham at Mount Wilson in 1932, reveal a great abundance of carbon dioxide in the atmosphere of the planet. Indeed this compound seems to be the main constituent in those levels that can be photographed.

While it is true that we cannot view any of the surface of Venus, improved photographic methods using film sensitive to infrared light have permitted the astronomer to obtain pictures to some depth below the outer levels of its atmosphere. And these have revealed some interesting things.

Photographs taken on film sensitive to ultraviolet light show indistinct shading in the upper atmosphere that seems to indicate continually changing form. This suggests great turbulence in the high clouds. But pictures made on plates sensitive to the infrared show a more or less steady haze below the far outer regions of the planet's atmosphere.

Because of the impermanent nature of the markings in the outer regions of its atmosphere, it has been impossible to learn the rate at which Venus may rotate on its axis. With most of the planets this can be found by noting the time required for some conspicuous landmark to reappear as the body turns on its axis. But this method is impossible with Venus due to the absence of well defined and conspicuous markings. As a result, astronomers are at a loss to know the length of its day. Were it comparable to our day it is certain that the spectroscope would reveal the period. Every indication suggests that it is much longer than 24 hours, and many astronomers believe that it requires about 30 of our days to complete one rotation. Since Venus completes its circuit around the sun in 225 of our days, this suggests that it may have not more than about 7 days to the year!

When we consider what conditions may prevail below the cloud layer, we are dealing not with observational evidence but with theories. And while the conclusions are based upon apparently logical reasoning, there is some disagreement among astronomers as to the over-all picture. Even the same authority may sometimes revise his views in the light of new evidence.

In 1940 H. Spencer Jones, the Astronomer Royal of England, wrote a fascinating and authoritative book entitled *Life On Other Worlds,* in which he discussed what was then known about the physical conditions of the planets and the question as to which, beside the earth, might support life. In the first edition of this book Dr. Jones concluded that, due to the great blanketing effect of carbon dioxide in the atmosphere of Venus, plus the fact that it receives much greater solar radiation than we do, its surface temperatures must be much above those that prevail on the earth. He suggested in that first edition that they are not much below 100 degrees C., the temperature at which water boils. Considering these high temperatures and the apparent lack of oxygen, he ruled out the possibility of either plant or animal life. However, he did picture great oceans and swamps on the planet and suggested a humid atmosphere. He went on to say that the conditions on Venus may be similar to those that prevailed on the earth in past geological times. He suggested that, as the sun cools and the environment changes, life might perhaps evolve on Venus to the level of intelligent beings.

In a recent edition of the same volume, we find that Dr. Jones has revised his theories. He tells us that, due to the apparent absence of water vapor in its atmosphere, we can hardly expect to find oceans on the surface of Venus. Nor can there be lakes or rivers but only an extensive and monotonous desert. He explains the atmospheric haze as the result of violent winds in the lower levels of the atmosphere. These storms, which he describes as much worse than anything we ever experience on the earth, churn up tremendous clouds of dust in the deserts and thus result in the haze that is revealed by infrared photography. He contends that it is largely because of the scattering of sunlight by these clouds that we cannot see the surface of the planet.

He also surmises that, due to the so-called "greenhouse effect" caused by the heavy layer of carbon dioxide, temperatures at the surface of Venus must be even hotter than the boiling point of water. And he further states that we must not be too hasty in concluding that the evolution of the atmosphere on Venus will duplicate the trend followed by the earth's atmosphere, implying that life as we know it may never develop there.

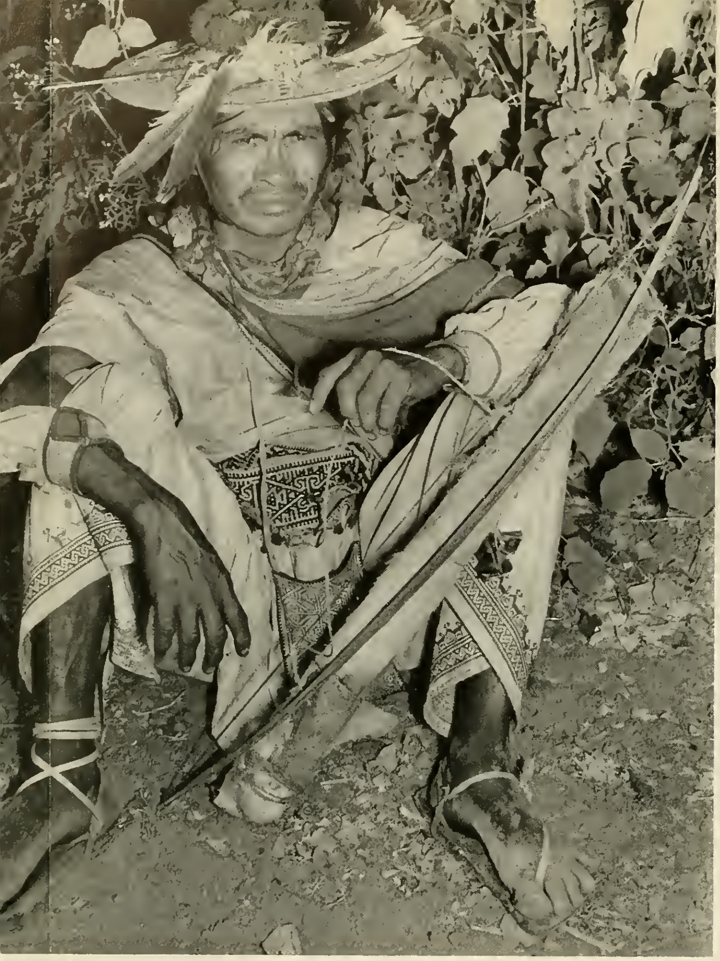
Comparing these views, as expressed in different editions of the same book, we might almost conclude that they were written by different authors. Yet the man who penned them both is one of the most reliable and highly respected of our modern astronomers. He is not given to drawing conclusions without first considering every shred of available evidence.

This is a perfect example of how the science of astronomy advances. Every theory is considered as merely an approximation to the truth. Its survival is entirely dependent upon the interpretation of new evidence gleaned through the giant eye of the telescope, coupled with the camera and the spectroscope.

A second theory is almost always more dependable than a first, yet we cannot by any means be sure that the clouds are dust. Actually no astronomer knows for certain of what they are composed.

Whatever the nature of these clouds, we know that our sister planet Venus is hidden beneath a veil that must shut out the sun by day and the stars by night. Like some others of her kind, she revels in the adornment of her costume, glowing in splendor under the rays of her ruling sovereign—the sun.

As she dominates the evening sky this December, we may enjoy the full radiance of her beauty and leave to the star doctors the difficult task of solving the mystery of her true self.



◂ "HERE," he said quite willingly. But he would not have his picture taken in the sun

Huichol

A glimpse into the life of a Mexican medicine man,

on the dusty trail from the Sierra to the sea

By GEORGE McCLELLAN BRADT

Photographs by the author

"THE Huichols adore water," wrote the explorer Carl Lumholtz half a century ago. "Water first, and water last, is the consideration in all their ceremonies, the centre of their thoughts."

There has been little change among the primitive Huichols of Mexico's western Sierra Madre since Lumholtz' day. Water is still the source of life. Without it in the form of life-giving rain there would be no crops of corn and squash and beans; and without gourds full of sacred water from the caves of the river Chapalagana, from the clear springs of the distant *peyote* country, from even the far-away, shining Pacific there could be no rain-making ceremonies—and no rain.

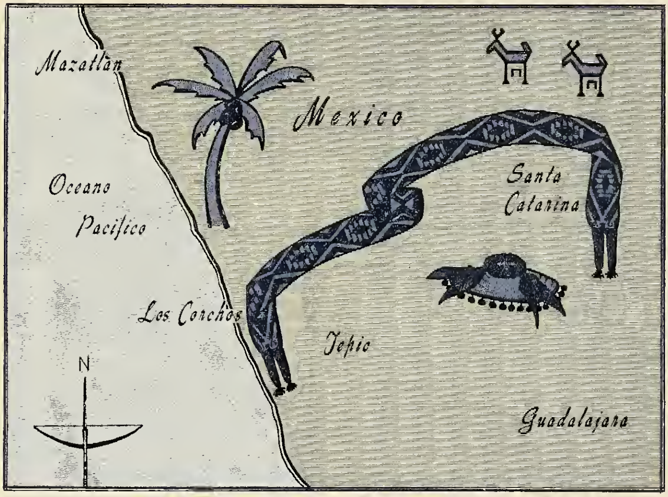
Pilgrimages to the Pacific play an important part in the religious life of the Huichol. The salty sea water is especially prized, since the ocean is not only the birthplace of all the gods but the home of the golden sun who goes to bed in its blue depths each night. Although the way is long and hard from the pine-clad slopes of the *Sierra de los Huichols* to the subtropical, mangrove-fringed shores of the Pacific, many Indians make this yearly journey. At this very moment a solitary Huichol, clad in scarlet cape and embroidered trousers, is probably making his way on sandled feet down the six-day trail from the Sierra to the sea. Three or four colorful pouches hang from his shoulders, and he is wearing a wide straw hat decorated with hawk feathers and red cotton pompons. In his hand is a bow and a deerskin quiver of arrows. After sacrificing a number of beautiful ceremonial objects to the gods and the ocean, he will fill a few bottles with sacred sea water and begin the long trip back to his mountain homeland.

Pilgrim

A few months ago my wife and I gave one of these pilgrims a lift in our truck. We were far south in the Mexican state of Nayarit, collecting insects for the American Museum of Natural History and trying to get from Santiago Ixcuintla to the coast. The sun was high, the day hot, and not a breeze stirred the palms and banana trees bordering the dusty road. It was one of those days that made us ask ourselves, "Why bugs and Indians and Mexico? Why not Maine and pines and the cold Atlantic?"— when, as usual, something turned up to make it all very much worth-while. The "something" was a wild-looking figure walking down the middle of the road ahead of us. It was our first Huichol.

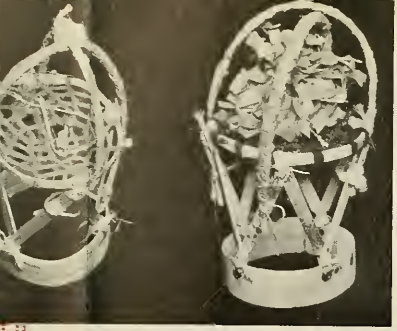
When we caught up with the Indian, we stopped and offered him a ride. He quickly accepted, but before getting in gave me his hand and asked, "*Como amigos?*" After I had assured him we were the best of friends, he tried to get into the cab of the truck but was stopped short when his bow got caught crosswise in the door. Only after he had unslung his bow and quiver, removed his amazing hat, and rearranged his water gourd, pouches, and razor-sharp machete was he able to get in with us.

During the next few miles we learned that he came from Santa Catarina, the most important of the six Huichol pueblos and the tribe's "mecca," across the Sierra in the state of Jalisco. He had been on the trail a week and was on his way to meet a friend already on the coast. After we had told him about ourselves and our work and had shared a little meal of bread and cheese, I felt that we were well enough acquainted to ask him to pose for a few photographs, for which I promised to pay him. He readily agreed, and we drove off onto a side road to get the pictures. By this time we were quite conscious of what Lumholtz felicitously described as "the distinct, though not strong" odor of the Huichol, which reminded him of "a wet dog, with the smell of smoke intermixed"; and we were ready for a little fresh air. Out of fairness to our passenger, I wish I had asked him his impression of his *gringo* friends' aroma—one which, after a hot week of bathless camping, was, I am sure, considerably "higher" than that of a smoky wet dog.

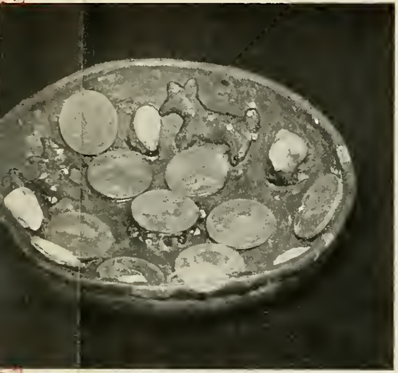


As soon as I stopped the truck, the Indian got out and walked off to sit in the shade of some low bushes. When I asked him to stand in the sun for the picture, he merely said, "*Aqui* (Here)," and refused to move from the shade. I was forced to take the photograph against a confusing background of

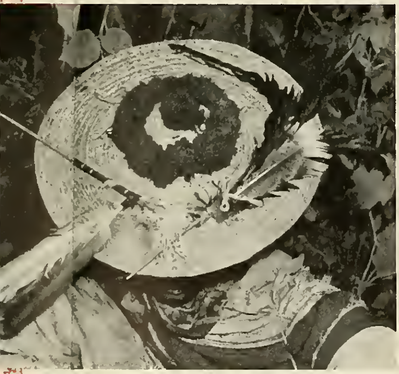
◄ THE INDIAN PILGRIM coming out of the sea with three bottles of the sacred water that he will carry to his mountain home for use in religious rites. On the beach are his ceremonial objects



▲ Gods' chairs: the first of the sacred articles he threw into the sea. These are four-inch miniatures of the sacred seats in which the shamans sit when talking and singing to the gods



▲ Ten Mexican pennies decorate the inside of this votive bowl, along with squash seeds and corn. This also was offered to the gods—so that they might drink in the prayers of the people



▲ A pair of "shaman's plumes"—feathered wands used by the medicine men when performing miracles—adorned his hat

green leaves. The Huichols have always been known for their independence. In fact, the Mexican ethnologist Carlos Basauri writes that, "Not for a moment will they admit that there is a race superior to theirs." There is none of the Tarahumara's shyness about the Huichol. The latter gives one the impression of knowing his rights as a man and an equal and of being prepared to stand up for them. When my model saw me start to put the camera away, he did not hesitate to ask, "And the *centavos* you promised me? I know you are going to sell my picture in your country." As I hastened to pay him he added, "I've been to Mexico City"—the Huichol equivalent of "I've been around."

Although we tried to acquire some of his beautifully made belongings, we had little success. After much pleading, he did consent to sell one small embroidered bag, but he emphatically refused even to consider parting with his handsome, woven woolen belt or with his fantastic, plumed, cartwheel hat, saying, "*No puedo, no puedo* (I can't, I can't.)"

It was not until several weeks later that we learned the probable reason why he would not sell us anything but the little bag. After comparing our notes and pictures with those in Robert M. Zingg's *The Huichols: Primitive Artists* and Carl Lumholtz' *Symbolism of the Huichol Indians,* we are convinced that our passenger was none other than a Huichol medicine man. Our photograph shows two peculiar bunches of feathers tied to wooden handles and fastened to the top of the Indian's hat. They are undoubtedly "shaman's plumes"—the sacred, feathered wands used by the medicine men to perform their miracles. No wonder he was unwilling to sell his hat. Perhaps most of his other belongings had religious significance as well. We were probably very lucky even to get him to pose for us.

As our distinguished passenger wanted to look around the near-by town of El Mango, we soon said good-bye, gravely shook hands, and agreed to meet on the coast the following day.

By the time we reached the eight-mile beach at Los Corchos, we were so hot and tired that we forgot everything except a cool swim in the Pacific. In fact, over an hour passed before we thought of our Huichol. But he was there on the beach—almost as if waiting for us. We left the water and walked toward him to see what he was doing.

He was seated behind a large driftwood log, facing the sea, busily at work painting the finishing touches on a small wooden disc he was holding in one hand. Beside him were his pouches, machete, bow-and-arrow quiver and a long, narrow, woven basket. At the north end of the log an arrow stood upright in the damp sand. Another arrow, with a hawk's feather tied to the butt, had been stuck into the top of the log itself. When we passed the Indian, he did not look up but continued working on the little plaque. It was evident that the pilgrim was about to begin the immemorial Huichol sacrifice of symbolic, sacred gifts to the gods. We did not wish to intrude upon so obviously personal a performance, so we walked off down the beach to watch him from a polite distance.

Within a few minutes he rose to his feet, took several unrecognizable articles from the woven basket, and—fully dressed—waded into the blue-green water. Fascinated, we watched as he took two small, basket-like objects and threw them one at a time into the water with an underhand, sweeping gesture. At this point two little Mexican boys, naked and brown, splashed into the water to retrieve the offerings. Although the Indian insisted that they return them to the sea, they refused to do so and brought them to us instead.

In the hand it was easy to identify the little objects. They were Huichol "gods' chairs," miniature replicas of the sacred chairs in which the shamans sit when talking and singing to the gods. They were cunningly made of bamboo and woolen yarn, probably by the pilgrim himself. The crossed arms of the chairs were covered with green and magenta tissue paper, and the seats had been fashioned of green and dark blue crewel. The holes in the base had apparently been burned through with a heated nail, and the various parts were held together with agave fiber string and yellow thread.

The second object offered to the gods was a small, shallow bowl. This was a sacred "votive bowl," the ordinary gourd drinking vessel of the Huichols decorated on the inside with kernels of corn, squash seeds, and ten Mexican one-cent pieces. According to Lumholtz, the votive bowls are "drinking-gourds offered to the gods who, so to speak, drink in the prayers of the people." In addition, there were two beeswax figures of deer, modeled in relief and embellished with tiny blue and white glass beads.

Then in rapid succession followed the remainder of the votive paraphernalia – the painted disc, several ordinary candles decorated with colored paper, three short ceremonial arrows, a little blue stick resembling the head of an animal, a second votive bowl, a tiny mat of fluffy blue and green wool, and finally the horns and upper jaw of a dried deer's head. By this time there were other spectators on the beach, and our little collectors were having stiff competition. They did succeed in getting us the arrows, wooden disc, and candles, but the second bowl and the woven mat fell to a young teacher from Mexico City, who would not part with the material but did let me photograph it.

The Indian then came out of the water, removed his hat as well as his long embroidered shirt and sandals, and returned to sit in the shallow water. This apparently constituted his ceremonial bath, for in about ten minutes he walked back to the log, picked up a toylike, foot-long bow and a short prayer-arrow sticking in the sand, and waded out into the surf once more. He fitted the arrow to the bowstring and aimed it high into the western sky. He did not shoot it, however, but simply threw it into the sea. This, too, was picked up by the teacher and was found to have a diminutive bow and pair of sandals tied to the shaft.

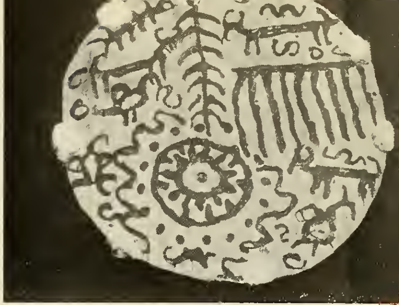
This completed the ceremonial objects that the Indian had brought to present to the gods in payment for the sacred water he had come so far to obtain. As a final act in the dramatic, ancient rite, he dipped a dark ear of corn into the salty water, returned it to the woven basket, and filled three little patent-medicine bottles, their labels still visible, full of sparkling sea water.

It was only when the Huichol brought the bottles out of the ocean that he offered any words of explanation. As he carefully put them away in one of the multicolored pouches, he said in Christian Spanish, "*Agua bendita para la iglesia* (Holy water for the Church)," which in pagan Huichol would have meant, "Sacred water for the temple." He then collected his various belongings and left the beach.

When he had disappeared, we sat down to examine our collection more closely. Probably the most sacred items of all were the short prayer-arrows. Concerning these Lumholtz wrote, "Ceremonial arrows, a kind of messengers to the gods, are inseparably connected with the life of the Huichol. The sacrifice of one or more arrows expresses his desires in a language intelligible to him and to the gods . . . for the arrow stands for him personally, and for the tribe, praying its silent prayers." The teacher also brought his material, and we were surprised to find the small, woolly mat filled with the living larvae of the Larder Beetle. Perhaps the mat and its squirming tenants represented a prayer for the extermination of an imagined plague.

Sitting there on the lonely beach, the only sound the breaking surf, it was difficult to believe that the spectacle we had just witnessed had actually happened. There had been an unreal, dreamlike quality about the entire performance, almost as

Continued on page 475



▲ THE TUFTS OF COTTON represent rain clouds in the religious symbolism of a people who adore water in every form. Three deer and a bird are also discernible in the complex pattern of this sacred wooden disc

▲ CEREMONIAL ARROWS, used for communication with the gods. They are about one-half as long as the regular hunting arrow and are often decorated with miniature votive offerings

▲ THIS PRAYER ARROW, sacrified by the pilgrim, had a tiny bow and a pair of sandals tied to its shaft. The votive bowl contains several beeswax figures, a bead design, a paper flower, and the usual cotton clouds

▲ HIGH OVERHEAD, the grasslike tassels of sugar cane wave above many small cane patches scattered through the South

SUGAR SEASON in the South

The arrival of winter marks the beginning of a picturesque home industry—the making of sugar syrup by methods handed down from early times

By LORUS J. *and* MARGERY J. MILNE

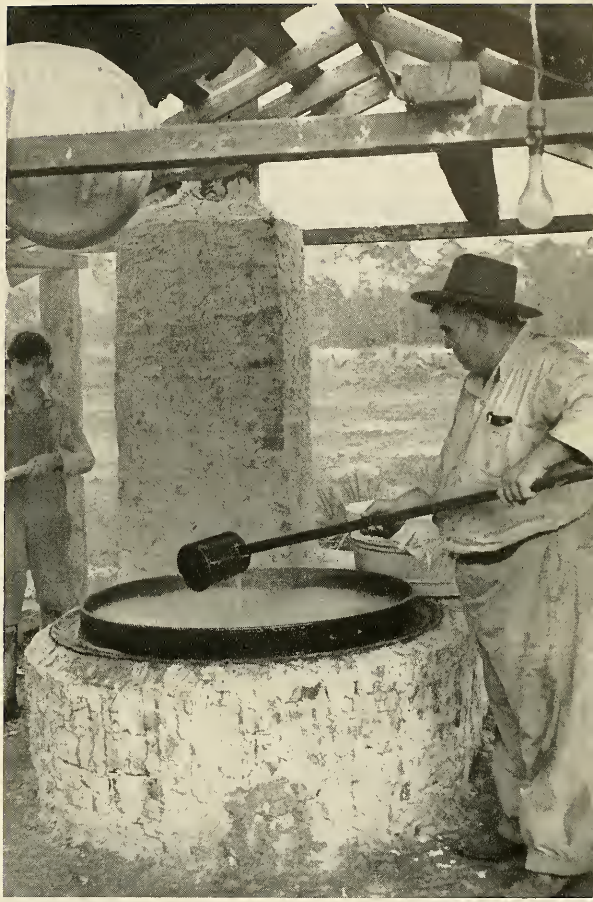
Photographs by the authors

TALL, jointed sugar canes, swaying gently in the warm breeze, their floppy, narrow leaves rattling slightly under a graceful grasslike plume twelve feet above the ground, suggest nothing to attract a sweet tooth. Yet scattered through the old South and Florida are countless centers where these canes pass through a simple mill to release a flood of sugary sap. Cauldrons of the juice steam and froth until the water has boiled away and syrup or molasses is obtained. This is the southern counterpart of operations in New England's maple orchards—but with some startling differences. Chilly air and sledding snow are part of the northern picture. Balmy weather and the beginning of official winter are central themes in the warmer industry. February frosts terminate the cane sugaring just as surely as maple tapping ceases when sunny days in March introduce a buddy flavor into the rising sap.

Sugar cane begins to reach its ripe perfection toward the end of November, and whole families work down the rows of their sweet acreages to strip the slender foliage until only the sturdy, glossy stalks remain. Some are purple, some red, some striped with green; the various kinds are distinguished by this means. Each stalk bears at few-inch intervals slight ringlike swellings from which the leaves arise, much as does a bamboo pole. Soon the ripe ones are felled, and the stiff, solid, ten-foot lengths are piled in a truck or wagon to be hauled through pine-studded palmetto prairies to some sugar mill. Often the road is merely a pair of ruts in the sand, past poor land on which humpbacked Brahman cattle find grass among the coarser weeds. Before it reaches a black-topped highway, the trail may splash through swales where egrets, ibis, and herons wade among the water plants. Or it may brush through live oak thickets hung with gray wreaths of Spanish moss and set with "air plants" that are relatives of the pineapple but suggest instead great bird nests built of hoary green leaves. These are but wayside parts of the vegetation that carpets great expanses and surrounds the richer islands of dark soil where sugar cane can thrive.

The little mills to which small growers take their canes still use the iron presses that have been handed down from the "yeahs befo' the wah." Only an ignorant damyankee would ask "Which war?" —there has been only one in these parts. But the mill is literally the center of activity. Around it runs a circular path about 40 feet across, beaten in the old days by the feet of a blindfolded mule. The animal (or its modern counterpart) pulls the end of a counterbalanced pole that lies across the mill and transforms the roundabout movements of the plodding puller into rotation of the mill's crushing drum. The iron throat of the machine—a vertical slot perhaps three inches wide and five inches high—accepts two or three canes at once and leads them to the revolving drum, which crushes them flat and then extrudes on its farther side a fibrous strand to represent each cane. This

▲ THE JUICE is crushed from the cane in a primitive circular mill turned by a blindfolded mule. Then it is cooked in the cauldron shown here



➤ THE FROTH frequently rises in the simmering pot and overflows down the iron ring set inside the rim. The liquid drains back into the cauldron through a crack, while the impurities remain at the top

sudden metamorphosis takes place all within a distance of a foot or so, while a sweet brown juice pours from the iron side through a spout that suggests in shape the outlet of an old-fashioned pump at a well. Who is there that is not eager for a glassful of the fresh squeezin's? Who would not roll on his tongue this new cane juice—many times as sweet as maple sap and just as distinctive in flavor?

Around and around goes the pulled end of the heavy pole. Within its counterclockwise circuiting, a man stands near the maw of the machine and feeds it canes picked from a pile laid parallel on the ground beside him. A small boy holds a bucket with a burlap strainer under the spout, while others scamper across the circular path to draw away the crushed ribbons from the mill or bring more canes to add to the shrinking stock. When the pail is full, another takes its place, and the brimming bucket is carried to the wife and mother of the family. She lifts the burlap, squeezes it fairly dry, and dumps the pailful into her cauldron. Over and over this process is repeated until the 60-gallon pot is almost full. Then the mill stops, for without refrigeration, juice that is not heated within an hour or so will spoil.

The kettle for boiling is imbedded to its rim at the middle of the bend in a U-shaped brick furnace built on the ground. A fire is started and fed through a square doorway at one end of the horizontal U, with wood tossed in skillfully to produce most heat in the immediate proximity of the pot. The hot air, smoke, and fumes continue around the U under the cauldron to emerge from a chimney constructed at the other end of the furnace—right beside the fire door.

While the extracted juice is heating, the children scurry around and enjoy themselves. They girdle short lengths of cane with pocket knives, then snap the stalks and split them into mouth-sized pieces that can be chewed. Guinea hens explore the pile of cane beside the idle mill, to tear off pieces of the plant and snatch at sipping flies. The man of the family and the older boys chop wood and stack the pieces

◄ THE HOT SYRUP, cooked to proper consistency and color, is filtered through a cloth—and one more "round" is done

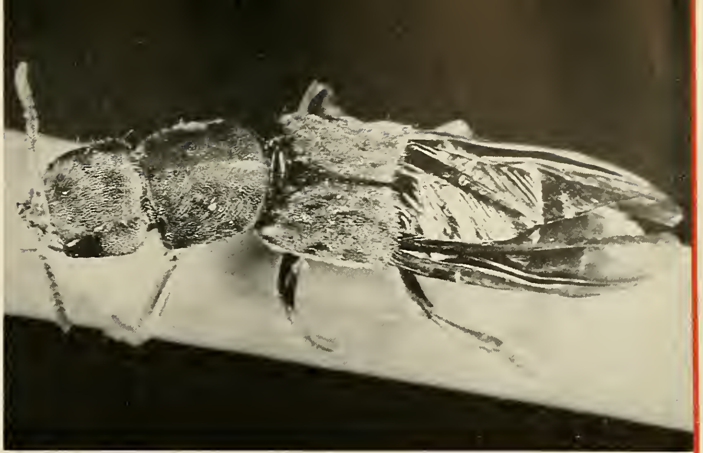
where they can be reached quickly when the fire needs fuel. There will be little more for them to do until the batch begins to steam.

Gradually the gallons of juice reach the boiling point, and glistening bubbles rise to the top to burst. Regulating the fire becomes an art, for the pot must be kept boiling without the upward surge of steam pushing the liquid over the side. Hour after hour the water turns to vapor and escapes. The foam becomes ten to fifteen inches thick, a seething mass of sparkling spheres that hisses quietly like a four-foot version of a freshly-poured glass of soda water. Impurities rise to the top and are skimmed away. This used to be a tedious, wasteful step in the process, since it was always difficult to remove the scummy bits without simultaneously losing syrup. Now the clearing of the broth is simplified by the installation of a false rim to the kettle—a ring of iron four inches high. The froth rises within the ring and overflows in little waves. As the bubbly stuff runs down the outside of the iron band, the gas escapes and the liquid drains back slowly through the crack between ring and pot. All this takes place within the gently sloping edges of the cauldron, so that nothing escapes but steam. The scum accumulates where it can be scraped away with ease, between the true rim of the kettle and the circling iron band.

Soon larger bubbles appear through the froth, and their bursting makes broad holes for a moment deep into the bead. "The change has come," and now the cook must watch with special care, waiting for the hot syrup to reach the concentration wanted. With a clean can fastened to a long pole as a dipper, the specialist (mill feeder, fire stoker, and now connoisseur!) reaches into the seething mass to raise samples that can be studied as they are poured back. Rapidly the color darkens, and the succeeding samples are thicker as they flow from the can. The last few trickles become cool enough to hang in strings from the inverted scoop. When they "hang real good" orders begin to fly thick and fast. Away comes the door to the furnace. Out come all the embers—raked into the open with frantic haste. Pailsful of water are thrown in to cool the inner spaces, for if the syrup boils further "it'll tear yo' bread apaht!" The bead vanishes. In the cauldron remains only a small dark concentrate from the original 50-odd gallons. It is ladled out with a larger dipper, into a tub covered with a clean cloth as a strainer. And as the last few cupfuls are removed, other workers stand ready with pails of water. Dashed into the kettle, the water dissolves the sticky coating before the remaining heat from below can dry it into a tarry mass. Washing the kettle proceeds with speed and enthusiasm. Everyone seems happy. One more "round" has been done.

This product is cane syrup, valued in local stores at a dollar-fifty a gallon and upward, depending on the reputation of the man who made it. He may express his personal preference by finishing each batch as "light," "medium," or "dark," with the color and sugar concentration in rough correspondence. None of it is molasses—a still darker and more viscous fluid, whose heavy flavor is due in part to several hours of extra heating, which bring it to an almost water-free condition. Nor does cane syrup crystallize under ordinary circumstances. The plant materials that give it its rich color seem to help prevent this transformation. Usually the syrup is the end point of an agricultural art that lends flavor to hot cakes and to coffee, to homey cookery of every kind. Only the old-style mill, the cauldron, cans, and buckets must come from the outside world. For the rest, the skills of a man and his family suffice. Pioneering versatility still has its respected place where there are ready hands and ample time. Cold cash loses some of the glitter seen on city streets when syrup is on the fire—whether in the maple groves of New England's hills or the cane patches of the deep South.

The Disappearing Wings *of the* ROVE BEETLE



▲ THE ROVE BEETLE with wings extended for use when flying

An airplane with collapsible wings has challenged man's ingenuity in recent years, but the Rove Beetle perfected such an arrangement ages ago

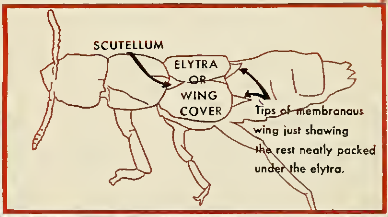
By LYNWOOD CHACE

CUMBERSOME wings that would hamper the insect when crawling in the grass are no problem for the Rove Beetle. Nature has provided it with folding wings that are neatly tucked out of the way when not in use.

When the insect alights, the elytra, or wing covers, come back against the body, and the membranous wings are folded flat against the top of the abdomen. With the tip of the abdomen, the beetle then tucks its wings back under the wing covers.

In taking flight, the wing covers are lifted above the body. Almost faster than the eye can follow, the wings unfold and spread out—and the Rove Beetle is off.

▼ THE SAME INSECT with wings completely folded and neatly packed under the elytra, or wing covers. The diagram at right shows where the tips of the wings are just visible, projecting from beneath the wing covers


SCUTELLUM
ELYTRA OR WING COVER
Tips of membranaus wing just showing the rest neatly packed under the elytra.

Tuber Foods of the OLD INCAS

Who can say where these delectable vegetables might have traveled if they had attracted the same interest as the potato?

By Walter Henricks Hodge
University of Massachusetts
Photographs by the author

▲ THE OPEN-AIR MARKET of a central Peruvian town regularly offers tubers for sale (ocas in right foreground) among other eatables

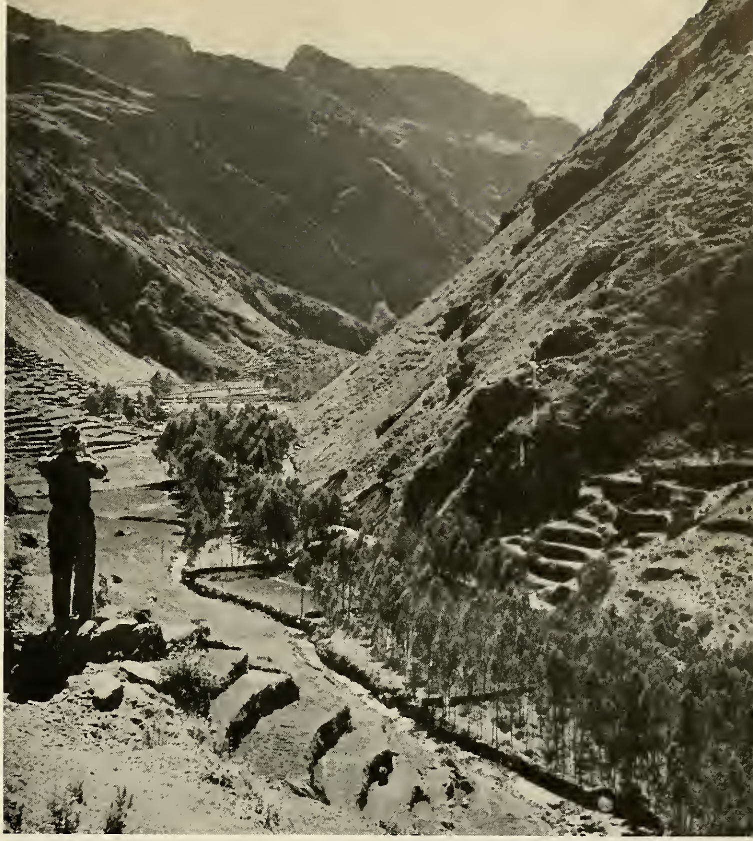
▼ LIKE A GIANT STAIRWAY to the sky, the spectacular Inca terrace gardens of Cuyo-Cuyo, Peru, tower above the tiny village nestling at 11,000 feet above sea level. On these old terraces, the tuber crops are still grown

IN the Andean highlands of Peru, the Indians have a proverb that says, "Stew without *chuñu* is like life without love." In this way they express their esteem for several edible tubers which, though quite similar to the potato, have never spread into the world market. To sample the various kinds is one of the pleasures of traveling in those remote mountains. And when one realizes how important these tubers must have been in the growth of the ancient Inca empire, one becomes doubly interested in them.

There must be something about the Andean environment that has favored the evolution of tuber-producing plants, for no less than four important species in four very distinct genera have been grown there by the Indians since before Columbus came to America. One of this quartet, the familiar potato, has since wandered to many parts of the globe, to become one of the most valued of all food plants, especially in temperate regions. In fact, the annual world production of potatoes much exceeds all the golden wealth taken out of Peru by the Spaniards. On the other hand, the potato's companions of the old Inca terraced gardens – those plants known in the Incaic Quechua tongue as oca (*Oxalis tuberosa*), ullucu (*Ullucus tuberosus*), and añu (*Tropaeolum tuberosum*) have remained in their highland homeland, unknown to the world in general though still important to the Indian populations.

Oca is most popular of the three today, with ullucu a close runner-up. In several widely separate districts of the Andes, in southern Colombia and southern Peru, the oca even rivals the potato in importance. The mist-shrouded village of Cuyo-Cuyo, which lies at the head of the Sandia ravine just east of the northern end of Lake Titicaca, is a most intensive center of oca culture. Here, beginning at 11,500 feet in the bottom of a narrow, steep-walled *quebrada*, ancient terraced gardens known as *andenería* rise tier above tier (some 150 of them!) on the precipitous mountainsides. One would have to hunt to find a more impressive display of old Inca terracing. Obviously, the valley has long been an important agricultural site. Many of the terraces are still in use, though some have been abandoned to pasture. Today, as undoubtedly five centuries ago, ocas and potatoes, and to a lesser degree ullucu and añu, are the principal crops grown.

Oca tubers are curious in shape, being slightly flattened cylinders, somewhat thicker than the thumb and averaging three to four inches in length. As in the potato, tiny scale leaves border upon the deep-set eyes. Belonging to the Oxalidaceae, the plant is a cousin of our smaller weedy sorrels and, like them, possesses reddish stems, clover-like leaves, and similar flowers whose orange-yellow petals are generally marked with fine purplish lines. The oca plant does not appear to set seed, a characteristic not uncommon in species long propagated vegetatively by man. And so, like the potato, oca is reproduced by means of its tubers, which are cut into "eye"-bearing sections at the time of planting.

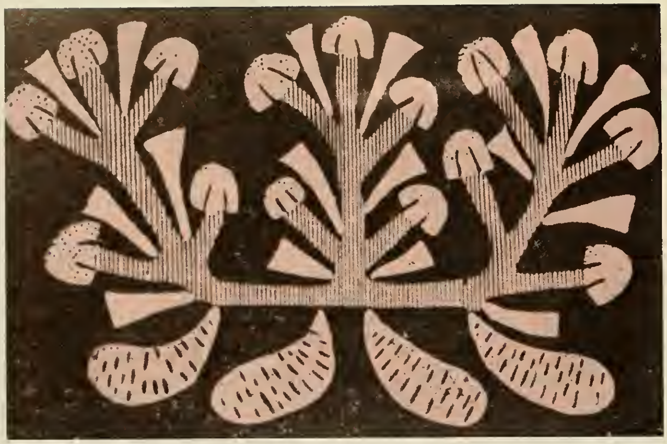


▲ In the heart of Tuber Land: a view looking down the valley near Cuyo-Cuyo. The introduced Australian eucalyptus tree shows its valued position as a source of timber and firewood in the important valley bottom. The little stream washes many a batch of "chuñu-to-be"

The Quechua Indians of Cuyo-Cuyo plant their oca at the beginning of the rainy period, which falls in August or September, but elsewhere in the Andes planting may be delayed several months depending upon when the rains arrive. The oca crop is treated exactly like potatoes, the plants being hilled up, with deep intervening trenches running down the slope. All the cultivation is by means of crude grub hoes or the primitive foot plow. Inca agriculturists practiced rotation of crops and fallowing, and so do their modern descendants. Thus the oca plant is generally interplanted or rotated in following years with the other tuber plants, with cereals, or with the European broad bean. Between growing seasons, llamas and sheep are pastured on the terraces, thus aiding in fertilizing the soil. In Ecuador or Colombia, where the lower general elevation of the Andes permits, one often sees rows of corn planted alternately with oca.

Approximately eight months after planting, the tubers are mature, and during April and May whole Indian families, including even the children and grandparents—all decked out in their colorful hand-woven ponchos and shawls—may be seen on the terraces harvesting the equally colorful crop.

The starchy oca tubers that they harvest are typical of the genus



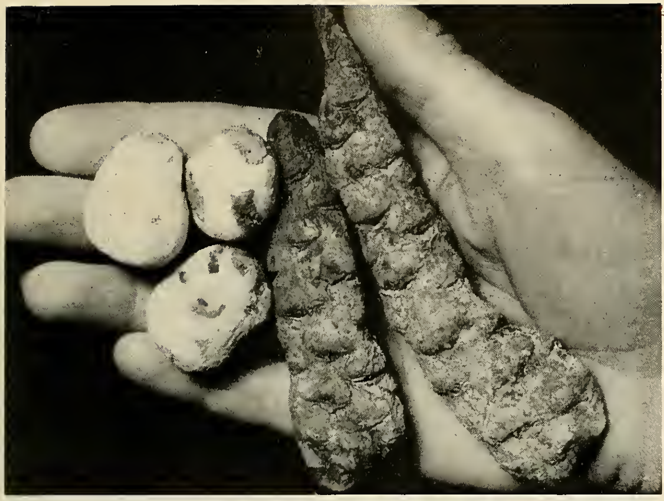
▲ AN INDIAN PAINTING from before the time of Columbus proves that the Inca civilization knew the oca. Though stylized, the tubers are well shown, and the trifoliolate leaves indicate the genus *Oxalis*

▲ THE OCA PLANT, a cousin of our weedy sorrels, has reddish stems, clover-like leaves, and orange-yellow flowers

▼ HARVESTING OCAS: a Quechua boy, dressed like his father with homespun felt hat and woolen stocking hat, or *chullo*

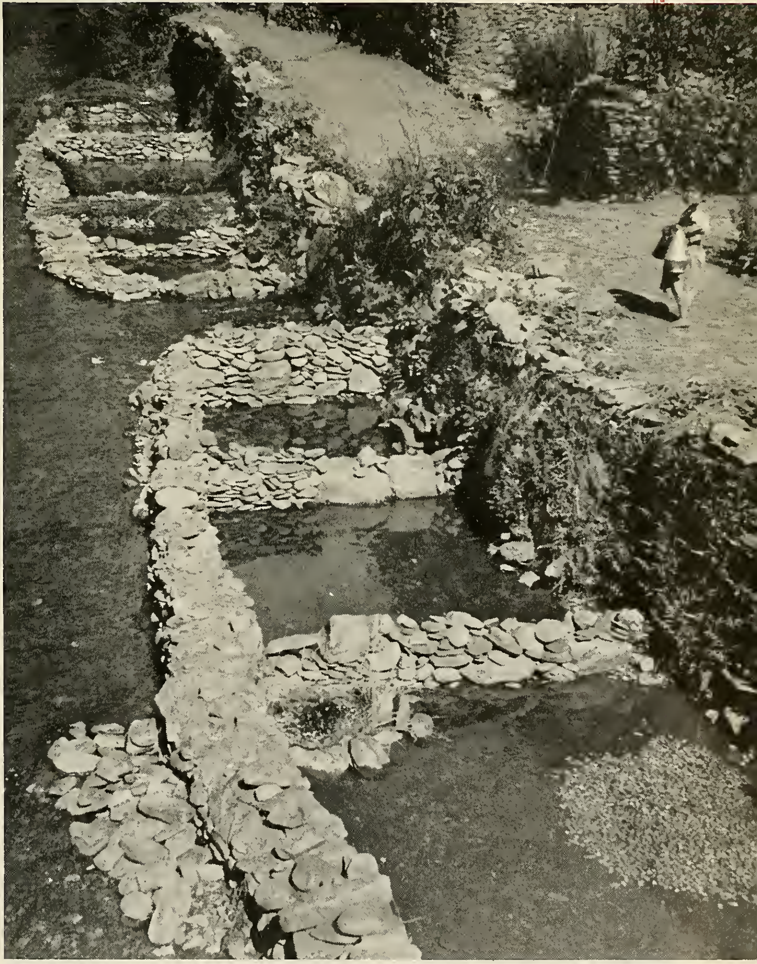
Oxalis in containing puckery crystals of calcium oxalate. Crystals are especially abundant in the bitter variety, and their presence makes it necessary to cure or ripen the tubers before they can be eaten. This is achieved by placing them in the sun for several days, after which the oca is sweet and can be eaten either raw or, more commonly, boiled in the stews and thick soups that constitute a basic portion of the serrano's diet. After the harvest season, all Indian doorsteps in oca country each day sport a few mellowing and colorful ocas destined for immediate consumption. The tubers have a very pleasant flavor when so prepared and may remind one of boiled sweet potatoes, though others have likened their flavor to a cross between that of green corn and pumpkin. Ocas are also delicious roasted or prepared like candied sweet potatoes. The sweet varieties are sometimes split lengthwise and placed in the sun to dry to form a product called *cavi*, which is cooked slowly in a crude double boiler and afterwards eaten with honey or homemade cane syrup as a dessert.

Since tuber harvests come but once a year, the Indians of the high Andes have had to devise some way of holding their semiperishable crop



< **Two types** of dehydrated tubers, or chuñu: ullucu at left and oca at right. Desiccated tubers like these will keep indefinitely

˅ **Before** the ocas can be dried satisfactorily, they must be soaked for three or four weeks. Pens like these are used extensively along the banks of the stream



through the year. Lacking controlled refrigeration, they adopted dehydration centuries ago. In dessicated form the tubers will keep indefinitely. The Quechua word *chuñu,* although perhaps originally applied to dehydrated potatoes, is now used for any dessicated vegetable.

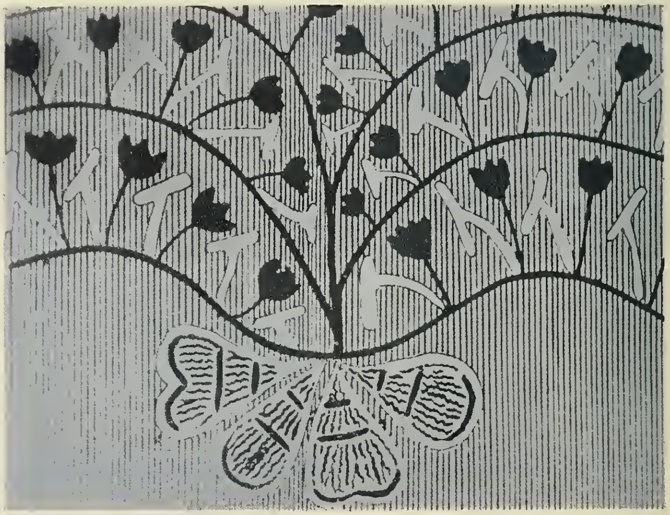
Among the varieties of oca, as among the varieties of potatoes, the bitter type makes the best chuñu, and for this reason this variety is most popular and widely used. Bitter ocas earmarked for dessication are, curiously enough, put in water immediately after harvesting and left to soak often for three to four weeks or until the eyes take on a purplish color. At Cuyo-Cuyo temporary pens of rocks are built along the sides of the swift glacier-fed stream that courses through the village, and during May and June quantities of tubers may be seen submerged in these watery bins.

After soaking, the tubers are spread out on straw in the open in any available area for about a week, usually at higher, colder sites. During this period they receive periodic freezing at night and drying by the intense sun during the day. At the end of this treatment, they are trampled upon to remove all vestiges of water. The wizened, thoroughly dehydrated oca product obtained by this procedure possesses a flesh that is grayish-white in color. Bitter potatoes, when given the same treatment, are peeled and yield a chalky "white" chuñu, while a "black" chuñu can be obtained by skipping the preliminary water bath.

Chuñu can be stored for long periods. Like most dried foods, it has to be soaked overnight before it can be cooked. In the *chupes,* or stews, that form the simple fare of the two-meal-a-day serrano, it forms a cherished addition, valued for its distinctive flavor.

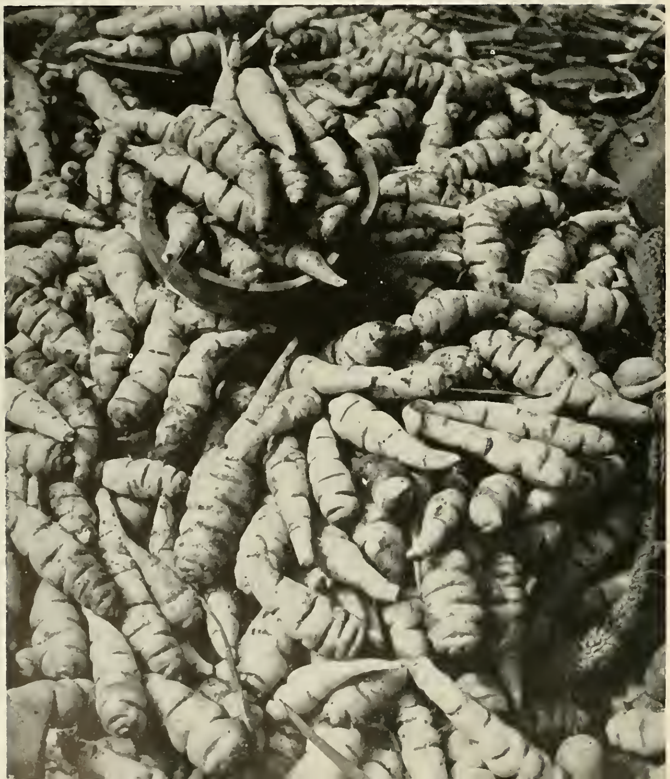
The highland Indians of the Titicaca area recognize at least ten varieties of oca. One of them, called *cjaya-oca,* is a popular bitter form with white tubers. It is used almost solely to prepare the chuñu known as *cjaya.* Several forms of sweet ocas are also grown, all with tongue-twisting aboriginal names: *sapallu-oca* with attractive yellow or orange tubers bearing red-margined scale leaves; *chachapea-oca* with grayish tubers; *pauccar-oca* and *lluchcho-oca* with red tubers; and *mestiza-oca* with white ones. Apparently the chief color variations are associated with floral differences, for it has been noted that yellow ocas have long-styled flowers, while white ocas have medium-styled flowers and red ocas short-styled flowers.

Following ocas in importance are the tubers of *Ullucus tuberosus,* a plant belonging to the modest group of the Basellaceae. In southern Colombia and around Cuzco, Peru,

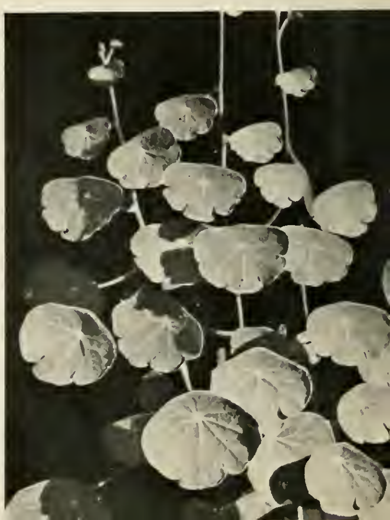


▲ THE TYPICAL UMBRELLA-SHAPED LEAVES identify this plant as añu, not the similar oca. The vinelike habit of this "nasturtium" is also clear, and the tubers are recognizable. (From Tiahuanacan pottery from the Upper Nasca Valley)

▼ A PENNY'S WORTH of añu, among a pile of the tubers, beckons prospective buyers to a stall in the Quito market. The vendor urged the author to buy them, stating they were especially good for bad liver or kidneys

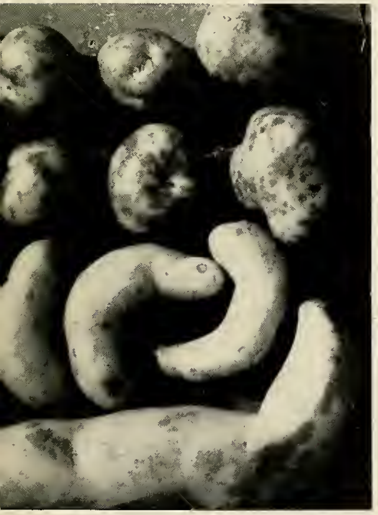


▼ FROM THE LEAVES, one would immediately recognize the añu plant as a first cousin to the nasturtium



it is outranked as a crop only by the ever-popular potato and maize. This tuber plant has a variety of names in the Andes, but the most common of these are the aboriginal appellations *ullucu* (from which the Latin generic name was taken) and the apparently Spanish modification, *melloco*.

Tubers of ullucu often look like small potatoes, and the casual observer might easily pass them up as just another one of the many varieties of potatoes common throughout Andean South America. As with the oca, several color variations exist, the commonest one being a pale magenta form which has apparently suggested the Spanish name, *rojas*, applied in Bogotá. Plain yellow tubers are also seen, as well as a curious yellow form speckled with magenta spots. These color variants may be either shaped more or less like a potato or long and curiously curved. The Quechua Indians of the Urubamba region near Cuzco prefer the curved form and call it *chchucchanlisas*. In its upright branching form, ullucu resembles its garden associates, the potato and oca. Its branches are similarly succulent and bear broad, heart-shaped, simple leaves, while the insignificant flowers are found on axillary racemes.



Two widely different forms of ullucu

Ullucus are popular with the highland Indians for several reasons. In the first place, the plant is very resistant to frost, an important consideration in the altiplano. In fact, it excels all other Andean tuber plants in this respect. Thus it can be grown in a wider range of sites and especially at the highest elevations for crops. Secondly, any species that gives a high yield in tubers produced per plant seems always to be popular. In this characteristic, the ullucu appears to be better than the potato and oca. It does not seem to matter that the tubers, though numerous, are small. The sierra Indians, unlike North Americans or Europeans, are not apparently impressed by size alone. Numbers count! The ullucu has the same range of culinary uses as does the potato and may be prepared as a chuñu as well.

It is curious that the tubers of the potato and ullucu are so similar, because the plants belong to entirely unrelated species. Even closer mimics are the tubers of the oca and añu, also unrelated. In fact, so nearly alike can forms of these tubers be that on one occasion I had to plant a questionable one in order to be sure of its identity! Tubers of añu seem to be slightly more conical than oca tubers, but the two are similar in their white to yellowish coloring, which is often mottled or striped with red or purple, especially around the eyes. In the fresh state, these tubers are said to give off a somewhat disagreeable odor, making it impossible to eat them raw, as is done with certain varieties of oca.

Although the añu's tubers are sometimes difficult to identify, the flowers and leaves are not, for one would immediately recognize this plant as first cousin to the familiar garden nasturtium (*Tropaeolum majus*), which also claims the Andes as its native home. In fact, these two species are often found growing together in Andean gardens, one as a crop, the other as a weed. And *Tropaeolum tuberosum*, like your garden favorite, tends to be a herbaceous twiner, clambering and anchoring itself on other plants by its tactile petioles. In this way, it covers the area of its growth with its smallish, five-lobed, green umbrellas. The flowers are orange-red to scarlet and are smaller and less showy than the horticultural *Tropaeolum*.

The añu has never been as important a crop as the other species, but its tubers can be found in most Andean vegetable markets, for they can be prepared in the usual boiled form to add occasional variety to the food. The highland folk may be more interested, however, in certain medicinal lore surrounding this plant, for an Indian woman in Quito assured me that the cooked tubers are especially good for bad liver or kidneys! The chroniclers record even more unusual, if mystical, uses prevailing in their time. Both Inca Garcilaso de la Vega and Padre Cobo state that the Indians believed that the tubers exerted anti-aphrodisiacal properties when used as a food. However, Garcilaso affirms that Indian gallants could counter-

➤ A young ullucu plant growing in a garden near Quito, Ecuador act this influence by "holding a small stick in the hand while eating the tubers." This magic property of a small stick must not have been generally known to the Inca's soldiery, because, according to Cobo, they were regularly fed this food during campaigns, on the Inca's orders "that they might forget their womenfolk."

This tuber trio produce their best crops in what may be called the potato zone, that is, in the Andean highlands lying roughly between 9000 and 14,000 feet. Such elevations are often subjected to nightly frosts. Even the day temperatures are cool, and during the rainy growing season, the plants experience a superabundance of misty and cloudy weather. However, the trio lacks the extensive latitudinal range of the potato, which in South America runs far south into Chile. Thus oca and ullucu are not found for any great distance south of the Bolivian highlands. Growing as they do close to the equator, with its almost equal days and nights, these species, like certain other equatorial plants, may not readily be adaptable to the long days of summer in the temperate zone.

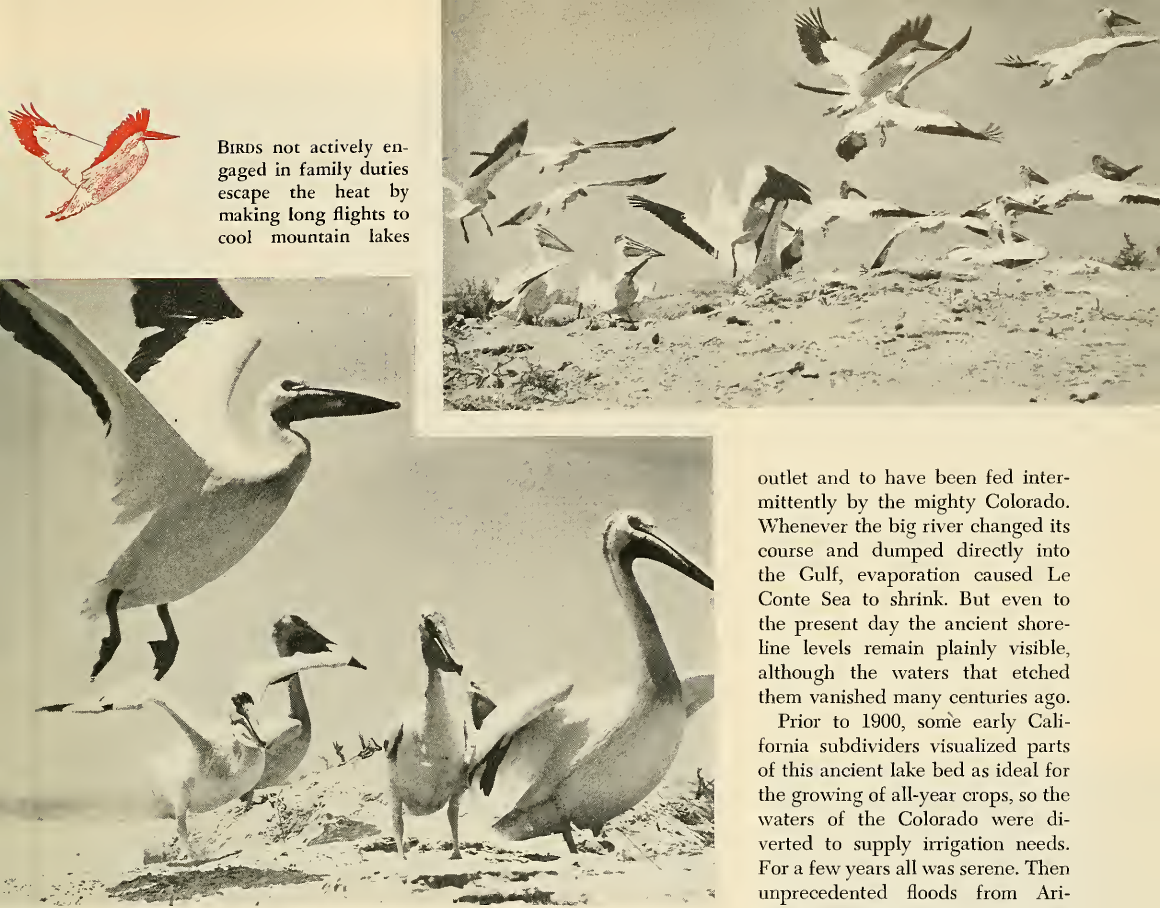
Our forgotten tubers appear to have had their original home in the old Inca heartland around the high basin of Lake Titicaca. More varieties are recognized there, and a greater number of native names are applied. Moreover the fringes of this very region have supplied us with proof of their use in pre-Columbian times, for Andean tubers, like many other economic plants, served as pictorial motifs, chiefly on pottery, among the peoples of the old highland civilization. Since these cultures left no written records, such pictograms have indeed been our best evidence of the importance of these tubers in early days. From the Upper Nasca Valley at Pacheco, Tiahuanaco age pottery (pre-Inca) has been found with beautifully stylized colored paintings representing the añu and oca. Of the ullucu we are not so sure because of its general similarity (in tubers and foliage) with the potato. Inasmuch as this trio was grown only in the moist highlands where stored tubers would soon disintegrate, no remains have been found in ancient highland sites, nor would one expect to find them preserved abundantly in the ancient tombs of dry coastal Peru. Yet recent studies of plant remains from coastal burial mounds show them as rare relics—apparently transported there in the form of chuñu. They are only recognizable through a careful microscopic study of the characteristic form of their starch grains, which differs in each of these species.

From the highland valleys of southern Peru, where we can guess their wild ancestors grew, the oca, añu, and perhaps ullucu were taken gradually northward. When, it is difficult to say. We do know that at the time of, or very soon after, the Spanish Conquest, these three plants were in cultivation in the fertile highlands of Quito, which at that time was the northern bastion of the Inca Empire. We are not certain, however, whether the ancient Chibchas of the northern Andes knew our trio. Possibly the plants moved into the highlands of Colombia and adjacent Venezuela after the Conquest.

Such indirect evidence as we have for this again comes from the chronology of the chroniclers. *Oxalis, Ullucus,* and *Tropaeolum* appear in the literature in that order, which is more or less the order of their importance as crops. Potatoes had been mentioned first by Oviedo in 1535; four years later Bishop Valverde of Cuzco, in a letter to his Emperor, first describes the oca; while the ullucu and añu do not appear in the chronicles until 1582, when they were recorded from the region of Cuenca in Ecuador. Indirect evidence of the northernmost extension of the tubers is presented unknowingly in the writings of Cieza de Leon who, telling in 1553 of a trip south through the Andes, fails to mention specifically any of our trio of tubers until after his arrival in Peru. However, near Ipiales (now on the Colombian-Ecuadorian frontier) he records that "the people grow an abundance of potatoes and '*otras raizes*' (other roots)." These "other roots" perhaps represent ullucus and ocas, which are grown very extensively in this area at the present time. More specific insight into the distribution comes from Colombia's famed patriot-botanist Caldas. Being a native of Popayán in southern Colombia, Caldas was presumably more than familiar with the crop plants of that country and especially with those occurring in the vicinity of his birthplace. Yet not until the early nineteenth century, when he made a trip overland to not-so-distant Quito, did he become acquainted with the oca, ullucu, and añu. He recognized ullucu as a species new to science and described it. In commenting upon it and its value to the local Indians he lamented that it, as well as the añu and oca, which were also popular in Ecuador, had not been introduced into his homeland of New Granada (Colombia). Thus if we are to believe Caldas, the tuber plants had progressed only as far as northern Ecuador by the end of the eighteenth century.

They have not and could not travel much farther. They have reached Venezuela and the end of the high Andes with their cool climate. But without the aid of man, they could not move northward into the highlands of Central America. That they were not grown by the ancient civilizations of Middle America may be explained, no doubt, by the same reason that kept the potato so long at home in South America: tubers deteriorate rapidly in the tropical lowlands, and until the event of rapid transport, they could hardly make the long jump to the Middle-American highlands.

This has been unfortunate, for although these plants may not merit comparison with the potato except in their superior keeping qualities, they do possess qualities that would make them a welcome addition in the diet of any tuber-eating folk. And who can tell how the world might have come to regard these little-known plants had they received the wide distribution and careful selective breeding that was accorded the potato!



Birds not actively engaged in family duties escape the heat by making long flights to cool mountain lakes

Refugee Pelicans

OF THE DESERT

Far from their usual haunts, they struggle to raise their young beneath blazing skies on the transient islands of Salton Sea

By Lewis W. Walker

Photographs by the author

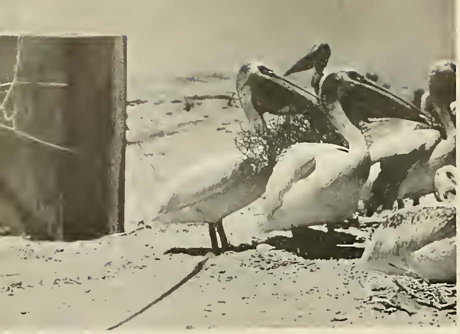
Coyotes, roadrunners, and rattlers are to be expected in the desert that lies between the southern California coastal range and the muddy Colorado. They are an integral part of this torrid belt of shifting sand. However, this land has not always been reserved for them alone. Water birds such as pelicans, geese, and cranes formerly frequented the area, as is shown by bits of charred bone excavated from the refuse heaps of the Indians that once camped on the shore line of ancient Le Conte Sea.

This sea nestled in the bottom of a tremendous sink or depression that is thought to have had no outlet and to have been fed intermittently by the mighty Colorado. Whenever the big river changed its course and dumped directly into the Gulf, evaporation caused Le Conte Sea to shrink. But even to the present day the ancient shoreline levels remain plainly visible, although the waters that etched them vanished many centuries ago.

Prior to 1900, some early California subdividers visualized parts of this ancient lake bed as ideal for the growing of all-year crops, so the waters of the Colorado were diverted to supply irrigation needs. For a few years all was serene. Then unprecedented floods from Arizona's normally peaceful Gila River overtaxed the crude dams, and the full force of the Colorado spilled once more into what is now known as the Salton Sink. Two years later, when the raging torrent was finally controlled, a lake about 80 miles long by 35 miles wide was left in the heart of the arid Colorado Desert.

During the two years of uninterrupted flow, several species of fishes as well as beaver and muskrat were carried to this below-sea-level spot, and they thrived on the spreading rushes and willows. Within a few seasons, birds commenced to settle on the body of water, and now it is the winter home for several species of geese, countless ducks, and 500 or 600 little Brown or Sand-hill Cranes.

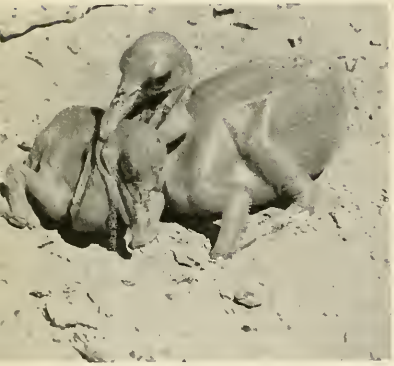
Birds on migration that usually nested in more temperate zones looked over the shores and the tiny islands of silt at the southern end,

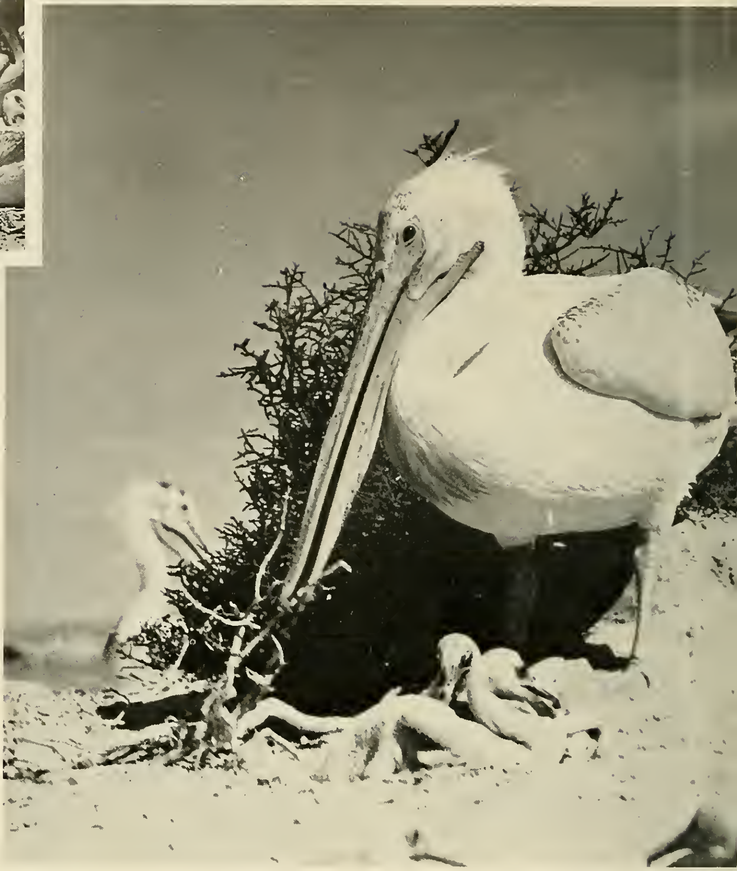


▲ HAVING GROWN ACCUSTOMED to the cameraman's blind, the pelicans were easily studied and photographed

➤ THE DILIGENT PARENT somehow recognizes its own chicks and feeds them on regurgitated fish. The common complaint that these birds are serious competitors of the fisherman is erroneous

▼ NEWLY-HATCHED PELICANS look like gobs of partly melted salmon-colored wax. There is little hint that they will grow into the bird whose bill "can hold more than his belly can"





and a few tarried to raise their young. These pioneers were queer types to be seen in the heart of a desert. Cormorants, which are more at home on wave-swept coasts, moved in and utilized the dying tops of the flooded desert trees. Grebes or hell-divers settled in the clumps of fast-growing tules, along with bitterns, coots, and rails. Even Gull-billed Terns, normal residents of the Atlantic Coast and the Gulf of Mexico, crossed to the Pacific and founded their only known western colony on these tiny islands of silt—islands that they now share with the white pelican, one of the largest water birds found in the United States.

These giants, with a wingspread that sometimes reaches almost ten feet, do not lead the same life in this burning desert that they do in their cool northern lake country. There they are comfortable when sitting on their eggs to keep them warm. Here they waddle onto the near-by shallows every 20 or 30 minutes throughout the hottest part of the day. It is tempting to conclude that they bring water on their feathers to cool the eggs. After a few rapid dips, I have seen them go back to the exposed eggs and appear to rub their dripping breast feathers over them. Then they seem to crouch over the nest to provide shade while normal evaporation cools off the eggs. But that the bird is actually aware of providing a sort of "desert refrigerator" for the eggs will doubtless be questioned. Some will say that they simply go for a dip to cool themselves and that the rest of the performance is happenstance. In any case, one can easily feel the difference in temperature between eggs that have absorbed the sun's rays for a few minutes and those that the parent has just vacated.

During the months of June, July, and early August, birds not actively engaged in family duties escape the heat by making long flights to cool mountain lakes. About midmorning the idle ones take off in a follow-the-leader formation, and the view of these fifteen or twenty must be alluring to others of their own kind. As they swing over the islands, single recruits constantly join the air-borne procession, which soon starts to use the rising currents of warm air over the desert to gain altitude. Within a very few moments the hundreds of birds, stretching for about a mile through the sky, become mere glistening specks against the blue. A "now you see it, now you don't" effect is achieved at every banking turn. If the sun hits the white feathers at just the right angle, the birds are visible; but as they bank away they become lost.

High in the air they straighten the line and set off on a general westerly course. Perhaps from their vantage point they can see their destinations—the lakes and reservoirs that dot the higher elevations of San Diego's mountainous country.

Late afternoon brings their return. With black - tipped wings flexed and sometimes almost closed, they plummet to within a few hundred feet of the nesting islands and then, spreading their feathers, slow down and land in a conventional manner.

Newly - hatched pelicans are among the strangest of bird infants, both in texture and color. If a gob of wax with a decided salmon tint were set under the desert sun and allowed to collapse, the resulting pile would be a good facsimile of these babies. Their skin has a translucent quality and is completely naked of both feathers and down. For the first few hours of their lives they are practically helpless, and they sprawl on the ground as though dead.

Within a week, however, a gray fuzz obliterates the sickly salmon tint and provides a shield from the sun's rays. About two weeks after hatching, the young gain the power of motion. From then until flight they wander all over the colonies and sometimes form into immense wriggling heaps in which each seeks the shade cast by his shade-seeking neighbor.

At mealtime, the onlooker is treated to the high-light show of the pelican colony. The parents, wandering aimlessly, are tackled by every famished fledgling, but these hungry young are usually shoved unceremoniously to one side. Finally, by some means, the correct offspring is identified and permitted to dine. After many awkward jabs, the fledgling hits the crack between its mother's mandibles and thrusts its bill far down into her throat. During this maneuver she is in the midst of a paroxysm called regurgitation and is pumping predigested fish into her crop. The head of the fledgling remains submerged for many seconds. Then the mother, as though tired of the constant probing of her now empty gullet, shakes the infant loose. For a minute or more the gorged young one staggers about the colony as though drunk, either through fullness or possibly lack of oxygen. The reeling intoxication is always followed by a sudden stupor, and soon the young one, falling flat on its face, temporarily passes out of the picture.

If you were to walk toward a just fed fledgling, it would awake with a start and try to run. Generally, however, the food would act as ballast and keep its breast to the ground. But within a few seconds its stomach pump would go into action, and the slimy fish just devoured would be left in a pile by the fleeing youngster.

The range of these giant white pelicans has been sadly reduced in the last century. At one time small colonies existed on many lakes, but such large birds of glossy white are tempting targets to a certain class of sportsman. During the duck season in the region of Salton Sea, I have seen them shot down

▲ After gaining the power of locomotion, the chicks cluster in large wriggling heaps, each seeking the shade cast by its neighbor

➤ "I think I'll take a dip." Every 20 or 30 minutes the hot birds waddle into the shallows of Salton Sea and left to rot where they fell. If such unwarranted wasting of life is questioned by a conservationist, he is given the old worn-out retort, "They kill sport fish." In eight weeks that I spent in the heart of these pelican colonies, I checked their foods at every opportunity. Carp, humpbacked suckers, and small mullet made up the bulk of their fare. Occasionally blue-gilled sunfish were brought in by the adults, but this was rare. The remains of bass were only detected three times in the hundreds of regurgitated fish that I examined.

Luckily, however, there are a few spots in the West where white pelicans are practically unmolested. But only a few of these breeding colonies are really sanctuaries where the birds are protected for their beauty and because their inoffensive nature is realized and appreciated. The advance of civilization has forced the birds ever backward, until now most of the dwindling colonies are in remote locations far from the haunts of man.

▲ PERSECUTED BY GUNNERS in their more familiar haunts, the refugees make the best of it under desert conditions

▼ WHITE PELICANS are among the largest water birds in the United States. Their wingspread sometimes approaches ten feet

HUICHOL PILGRIM

Continued from page 459

if we had imagined the return of a ghostly Huichol through five forgotten centuries to give us a flash back into the irretrievable past. The ceremonial objects we were holding—beautiful examples of the seldom seen symbolic, plastic art of the Huichols – were the only evidence of the Indian's recent presence.

The one thing that in any way marred the unforgettable event was the half-guilty feeling that, by depriving the gods of their rightful presents, we had possibly antagonized the devout pilgrim. But when we read in *Unknown Mexico* that even should a collector take away ceremonial objects, "the Indians, though of course annoyed, would fear no evil consequences for themselves, since they had performed their duty," we felt considerably better. Actually, "the matter would have to be settled between the god offended and the offender, who would be punished with illness or accident." And the Huichol would have his already unshakeable faith in the omnipotence of his gods even further strengthened could he but have seen us within five hours of his departure. My wife was well into the first attack of malaria with a fever of 106 degrees—punishment enough for being an accomplice in the appropriation of the gods' sacred gifts!

DESERT FISHES — CLUES TO VANISHED LAKES AND STREAMS

Continued from page 451

factor in its evolution, for any changes (mutations) appearing in the population would be rapidly assimilated through close inbreeding of the few individuals. There is evidence, now being tested, that the Devil's Hole fish has become so highly adapted to the warm temperature of its environment that it cannot survive at temperatures much cooler than 85 degrees F.

Death Valley supports two kinds of *Cyprinodon,* inhabiting salty creeks and a warm spring on the floor of the valley. *Cyprinodon nevadensis* differs considerably from *diabolis.* It is larger in size and possesses pelvic (belly) fins and, in the male, a black-bordered tail. Also, the scales are larger. This fish inhabits the saline, terminal flow of Amargosa River, which rises near the old mining town of Beatty, Nevada. The name Amargosa is from the Spanish, meaning bitter—a most appropriate description of this artery of brine and alkali running through the desert.

In Railroad Valley, west of the headwaters of White River, lives the spring fish, *Crenichthys.* Although now separated by high, arid divides, it is evident that some sort of a waterway once connected Railroad Valley with the White River. Again fish distribution gives us the key to this deduction, for a related species of *Crenichthys* is widespread in the old White River basin. The nearest living relative of *Crenichthys* is another relict, *Empetrichthys,* a fish confined to the Death Valley system. It inhabits springs and their outflows in Pahrump Valley, just across the Nevada border from Death Valley, and in Ash Meadows, along the California-Nevada line. None of these killifishes reach a length much greater than three inches. The occurrence of *Empetrichthys* in Pahrump Valley and Ash Meadows (of the Amargosa River basin) testifies to a former hydrographic connection between these now isolated regions, although geologists have yet to supply the confirming physiographic evidence. Members of this genus were once thought to be closely related to a killifish inhabiting Lake Titicaca and other high Andean lakes, but the resemblance proved to be only a superficial one.

Cyprinodon is known elsewhere in the West only from the lower Colorado River basin, in Arizona and Mexico. Thus the presence of this genus in the Death Valley system forces me to conclude that there was once a surface connection between the Death Valley system and the Colorado River or its antecedent. Such a connection has been suggested by geologists. Now nearly 200 miles of scorched desert lie

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between Death Valley and the Colorado, but a series of structural troughs, which once contained Pleistocene lakes, extends south and east from Death Valley. These troughs may represent the route along which the ancestors of the Death Valley species traveled. The connection was evidently an old one, however, for any trace of a connecting channel has been erased, and a fossil *Cyprinodon*, from Late Pliocene or Early Pleistocene beds in Death Valley, tells us that the genus inhabited the region perhaps as long ago as a million years.

The study of desert fishes is indeed fascinating. It not only helps in the reconstruction of the past face of the desert and in studies of the evolution of species, but repeated travels in the region bring one to appreciate the clean, vast expanse and singular beauty of the desert. The spell it casts over those who know it well is a bond not easily broken, and the saying "once a desert rat, always a desert rat" is well founded.

Continued from page 439

than portions of some of the subjects in this ambitious work. Such sharp restriction is imposed by requirements of space that omissions naturally occur. I look in vain under Cytology (page 31) and Genetics (page 313) for any mention of polyploidy, a genetic phenomenon important in controlling the differentiation of many races of domestic plants.

The map on page 239 should be redrawn. Asia and Australia are shown therein united by "the comparatively shallow continental shelf . . ." It is well known that very deep water intervenes. On page 285 the statement is made that, besides the dingo and more recent man-made introductions, "the only other placental mammals in Australia are the long-flying (*sic*) bats." What about the numerous indigenous genera of rodents of Australia and New Guinea? At the foot of the same page comes the sentence, "There are marsupial MONKEYS (caps, the author's), but they have the unexciting appellation of tree kangaroos." Most mammalogists will agree that the word monkey, even in simile, should be omitted from the list of the Australian fauna. Anyhow tree kangaroos no more resemble monkeys than squirrels resemble marmosets. The recapitulation (page 376) of Wallace's views on faunal distribution in the East Indies may be worth-while. But surely some mention ought to be made of the modern views regarding the relationships of Wallace's and Weber's Lines to the exposed continental shelves and the lowered sea levels of late Pleistocene time. Though the criticisms mentioned above are minor, all are perpetuations from the 1941 edition.

The book contains many excellent articles, among which may be emphasized the paragraphs and photographs illustrating bad and good soil treatment (pages 192-193). These ought to be engraved on the mind of every farmer in every country.

G. H. H. TATE

SKYSHOOTING

- - - - - by R. Newton Mayall and Margaret L. Mayall

Ronald Press, $3.75
174 pp., 59 illusts.

IN *Skyshooting*, the authors prove their statement: "The real glory of the heavens lies not in what you see with your eyes, but what your camera sees." Excellently illustrated with photographs done by amateurs, this book describes how to make any camera reveal beauty in the sky which cannot be seen with the unaided eye. No telescope is required.

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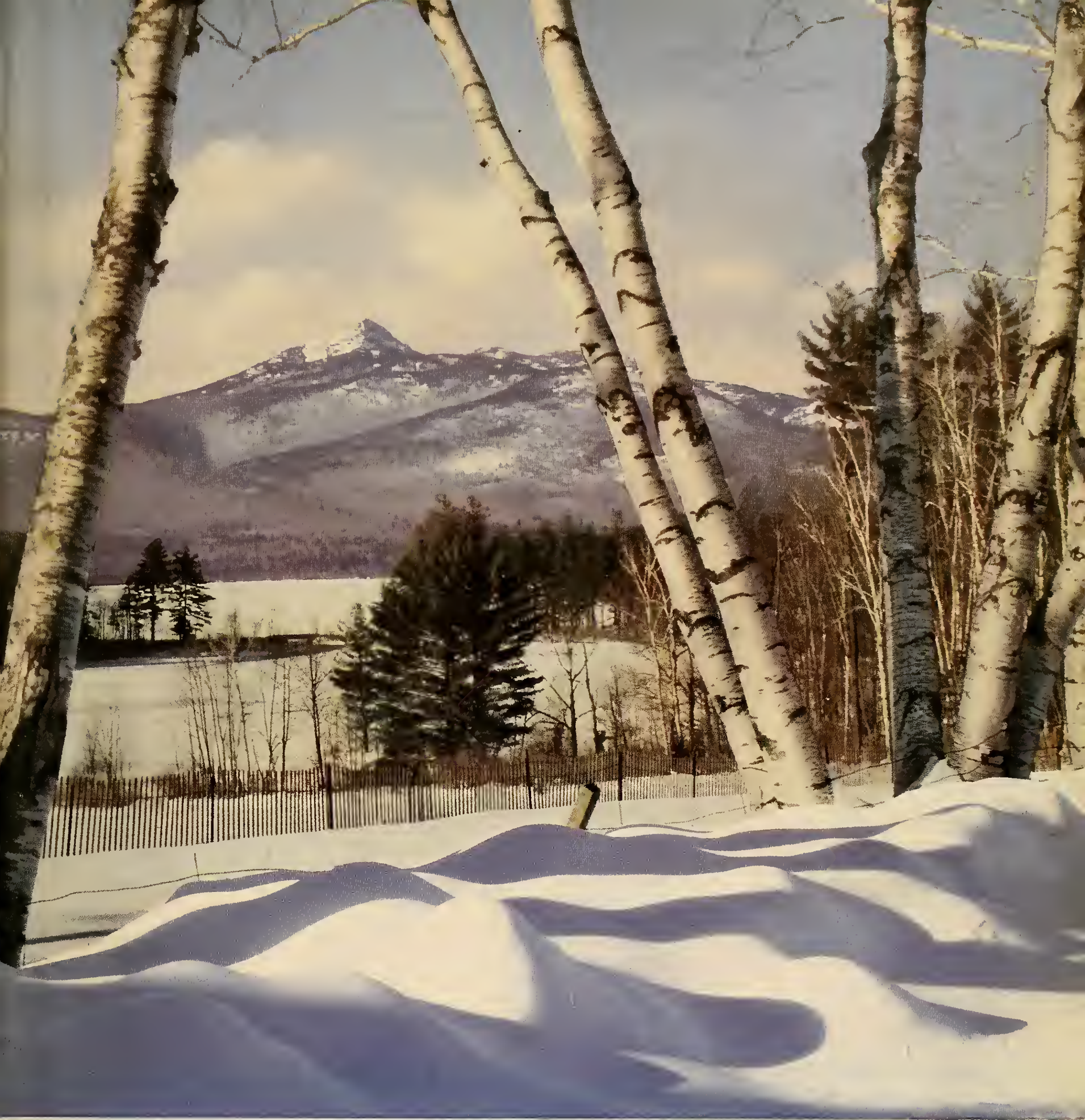

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LETTERS

Not a Knot

SIRS:

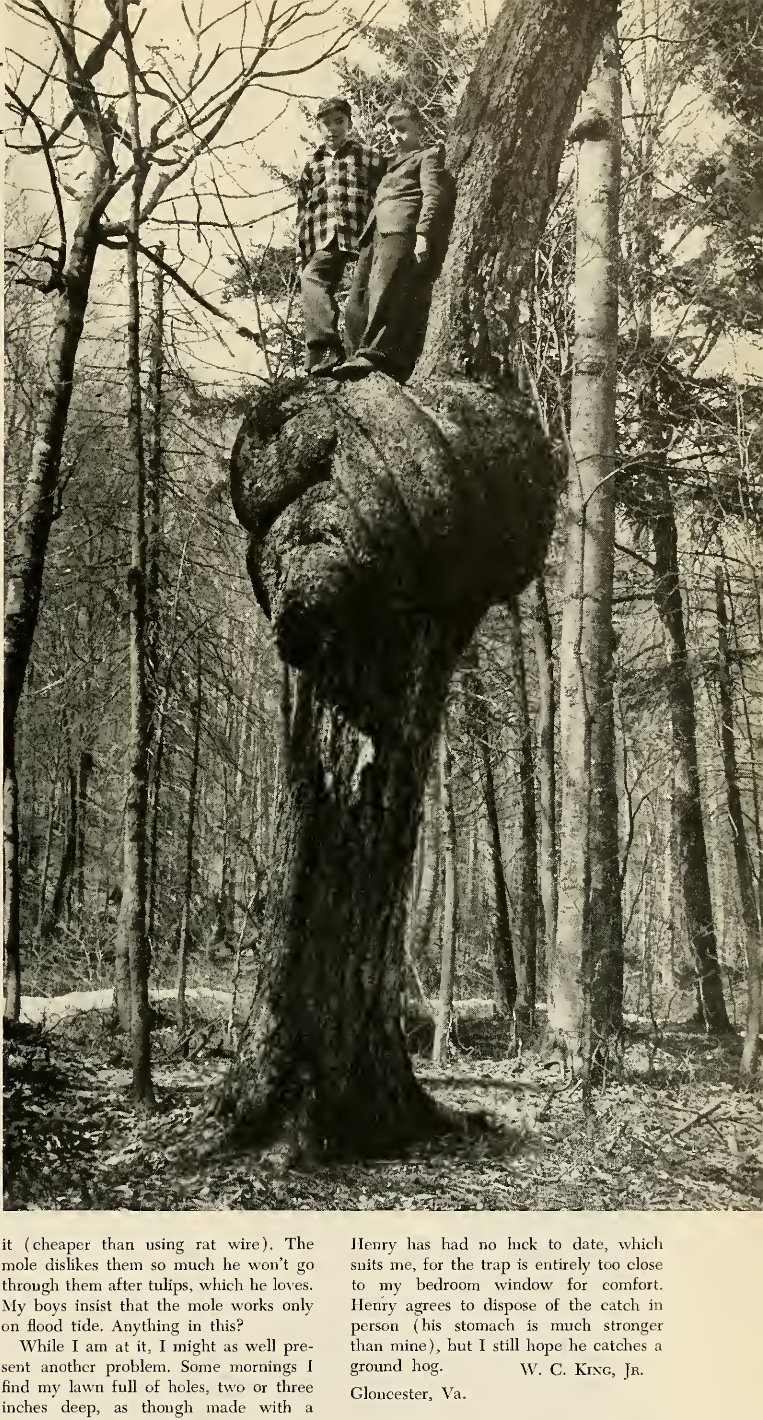
I wonder whether your readers may find as much interest as I have in this remarkable tree—a maple I believe—located in the Piseco Lake area of the Adirondack State Forest.

A friend has rendered the opinion that the tree may have been struck with an ax or other implement when it was younger and that it produced an excessive formation of bark in the effort to overcome the injury or infection that resulted. Do you concur?

GLEN DALTON.

Scotia, N. Y.

The literature indicates that galls and burls and other abnormalities are caused by various things. Some are pathological, involving bacteria and fungi; some are physiological, due possibly to nutritional disturbances; some are caused by parasitic plants (mistletoe), forming "witches brooms"; and some have been attributed to insects. It would be impossible to state what agent caused the formation shown in this photograph.—ED.



King or Gangster?

SIRS:

To Mr. McHugh, the mole may be "Little King of the Underworld" (NATURAL HISTORY, Oct., 1949), but to me and my neighbors, he is something unprintable. I have about 180 acres for moles to tunnel through, and if the "Little King" would keep out of my flower beds and front lawn—less than an acre—all would be well. But no, he won't play that way. I do not suppose Mr. McHugh would help me in my efforts to exterminate his pets or, to put it in a nicer way, confine them to their share of my property—a nice 179 acres.

There is one point I think I should make. Mr. McHugh says, "Prized daffodils are felled." Our experience down here is just the reverse. Daffodils, jonquils, and narcissus (I don't know which is generic) are grown here commercially. "The Little King" won't touch the bulbs. In fact, the way to protect a bed of fancy tulips is to plant a row of jonquils around it (cheaper than using rat wire). The mole dislikes them so much he won't go through them after tulips, which he loves. My boys insist that the mole works only on flood tide. Anything in this?

NOTICE—Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on these pages will be paid for at $3.00 each, with full credit to the photographer. Return postage must be included.

While I am at it, I might as well present another problem. Some mornings I find my lawn full of holes, two or three inches deep, as though made with a pointed stick. I blamed the ground hogs, but Henry, my outside boy, says it is brother skunk, and he has set a wire trap, baited with a piece of chicken, to catch the raider next time he goes grub hunting. Henry has had no luck to date, which suits me, for the trap is entirely too close to my bedroom window for comfort. Henry agrees to dispose of the catch in person (his stomach is much stronger than mine), but I still hope he catches a ground hog.

W. C. KING, JR.

Gloucester, Va.

Tom McHugh, the author of "Little King of the Underworld," offers the following comments:

The distastefulness of daffodils to

moles is a very interesting point, since I have discovered no records that this creature is such an epicure. It is entirely possible, however, that the list of plants unpalatable to various animals is indeed a large one.

Even the fact that moles eat tulips is a fairly controversial subject. Examination of the stomachs of several hundred eastern moles has proved that the bulk of their diet is earthworms and white grubs. The western species of moles are quite different, however, since they consume a much greater quantity of plant material. They will readily eat tulips, bulbous irises, carrots, parsnips, and beans.

Much damage to garden greens is erroneously blamed on the mole. After our little king splits the earth into a maze of underground tunnels, he is no longer the sole owner of these galleries. Numerous other small mammals, especially shrews, meadow mice, and deer mice, find the mole's tunnels very convenient highways for traffic and for marauding. These trespassers hurt the reputation of the mole, for he is accused of much of the injury to seeds, grains, roots, and tubers that actually is done by other intruders.

A study of tooth marks on the damaged products will bear out this statement. Since the mole's short teeth are not meant for gnawing, the damaged roots are mangled rather than cut clean. Work done by rodents can be detected by the sharp tooth marks.

These intruders also bring other trouble to the mole in his supposedly safe underground castle. Voracious shrews are a constant threat to nestling young, and invading snakes may be one of the few predators of the mole.

The idea that moles work only at flood tide is quite erroneous. The earth-cleaving habits of this animal require an enormous amount of energy, which in turn depends on a gluttonous appetite. Periods of rest are abruptly ended by pains of hunger, and the mole surges forth again through the soil in a never-ending hunt for food. He has no time clock to punch and works intermittently day and night.

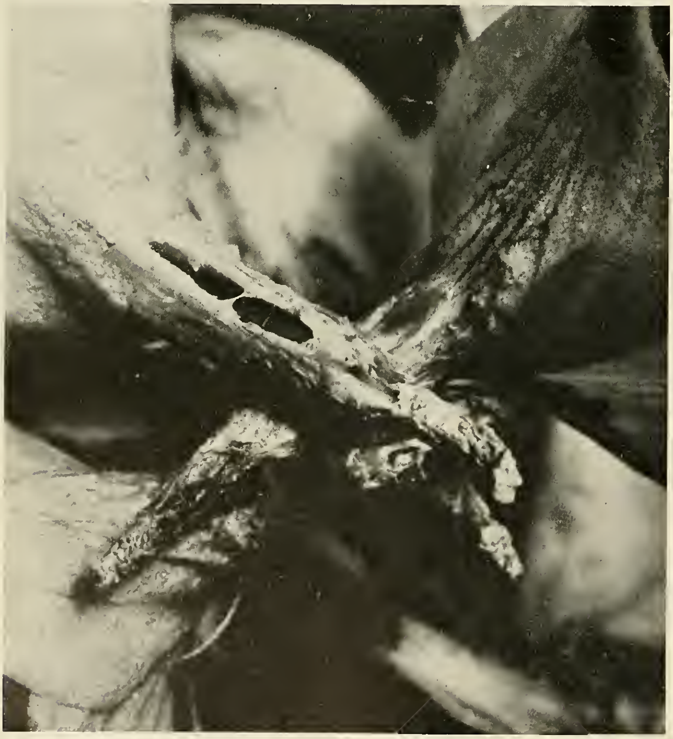
As Mr. King can prove, moles may become very annoying pests and must, therefore, be removed. Trapping is the most satisfactory method of controlling them, but it is successful only if the habits of the mole are carefully considered. Advantage can be taken of the fact that the mole is not suspicious of dirt blocking the runway. This habit provides opportunity for using a specially designed trap that straddles the runway with the trigger pan resting on the dirt blockade. As the animal travels through his tunnel and pushes through the barrier, the arms of the trap are sprung and catch him.

If hose connections are available, moles may be drowned out by flooding the runways. This works best during April, when the undeveloped young are most likely to be in the nest.

Since the mole tends to avoid obnoxious substances, repellents may be placed in runways. Lye, paradichlorobenzene, and naphthalene seem most effective. The ridges should be opened with a small stick at intervals of about ten feet. After a teaspoonful of one of these materials is inserted, close the opening carefully. Applications should be repeated whenever sections of old runways show signs of being used or when any new ridges appear.

Fencing small areas with woven wire or concrete is practicable where valuable plants require special protection. Galvanized hardware cloth with three meshes to the inch will exclude mice as well as moles. Concrete walls one inch or more thick have been found cheaper in the long run.

The holes in Mr. King's lawn are more than likely due to skunks, which like to uproot patches of sod in their search for the grubs that lie just underneath.



Bees and Pilot Whales

SIRS:

Your letter from Dr. E. P. Andrews on insects that make a short cut to the nectar in flowers reminded me of proof of such pilfering offered by photographs taken some years ago. Herbert F. Schwarz, in commenting on Dr. Andrews' letter, mentions the plant genus *Aconitum* as being the prey of a European bumblebee. Our handsome perennial larkspurs (*Delphinium*) are close relatives of the aconites, and their longer nectariferous spurs make them difficult of access to all except long-tongued insects. In my garden, bumblebees regularly chewed a short cut to the nectar supply, as this photograph (*at left*) attests. I, too, noted that honeybees often took advantage of such perforations, once opened.

The interesting article on pilot whales (September NATURAL HISTORY) arrived the same week that I viewed a friend's amateur movie taken of a school of "blackfish" stranded on Lieutenant's Island, near Wellfleet, Massachusetts.

An attempt was repeatedly made to "launch" smaller individuals of this stranded school. A "blackfish" would be worked into navigable water and headed seaward, but in each instance, it turned about and hopelessly rebeached itself.

More amazing was the fact that during the launching maneuvers it was found that if a bather mounted the "blackfish," it made an excellent and docile steed. Some of the best pictures in the film showed a person "cruising" through the waters of Wellfleet Bay mounted on a pilot whale! It seemed that the blowhole served a double purpose—as an invagi-

Continued on page 46

NATURAL HISTORY

The Magazine of the American Museum of Natural History

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VOLUME LIX—No. 1
JANUARY, 1950

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You will find Natural History Magazine indexed in *Readers' Guide to Periodical Literature* in your library

THE COVER THIS MONTH

Traveling by automobile along State Route 16 in New Hampshire, thousands of visitors every year pass the lovely grove of white birches that gives you a touch of winter on this month's cover. Framing a stunning view of Mt. Chocorua, these birches make one of the most photogenic foregrounds to be found anywhere in a much photographed state. Mt. Chocorua, 3475 feet high, is named for an old Indian chief of the early Pequawket Tribe. One of the more southerly of the White Mountains, it is often considered the most beautiful peak in New England.

In summertime, the deep blue of Chocorua Lake sparkles at the mountain's base. Eighteen miles to the north is the popular resort area of North Conway, and fifteen miles south is Lake Winnepesaukee. Thus, Mt. Chocorua and its birches are at the hub of a scenic vacationland.

Jack Breed caught our striking cover vista on a blustery February afternoon when the temperature was near zero. The exposure, on 5x7-inch Ektachrome daylight film, was 1/5th second at F18.

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YOUR NEW BOOKS

Margaret Mead: Male and Female • Peru

Tropical Aquariums • Indians • Poppy

FROM CAVE PAINTING TO COMIC STRIP

---------by Lancelot Hogben

Chanticleer Press, $5.00, 288 pp.
20 pp. full color, 211 black-and-white illusts.

THIS kaleidoscope of human communication is a delight both to the eye and to the mind. Ably organized and well written is this story of man's self-education by means of calendars, alphabets, number systems, mechanical and anatomical drawings, musical notation, pictures, and photographs. All this in a book of less than 300 pages would appear to be but wishful thinking, not capable of execution. However, biologist and medical statistician Hogben and visual aid expert Marie Neurath have combined their talents to achieve a high degree of success in this venture. It is the illustrations that make it possible to maintain a reasonable coherence in presenting this panorama of man's attempts to communicate with his fellows. This is no attempt to belittle the author's skill in popularization. Hogben has already established himself as an expositor of considerable effectiveness with his earlier works, *Mathematics for the Million* and *Science for the Citizen.*

Cave paintings start this story, and comic strips come in near the end, but in between is the amazing history of man's development of the various media of visual communication.

Especially pertinent is the final chapter on *The Internationalization of Free Speech.* Hogben presents a concept well worth considering. It is simply this. The complex, nervous, and suspicious world of today calls for easy, clearly understood communication between the peoples of the various nations. Some kind of international language or rather international communication is needed. It should be a medium easily learned and independent of all grammatical apparatus with the exception of word order. It should overstep the usual language barriers. Hogben suggests a picture language. When you finish this book of his you are inclined to hold with him. When he shows you how civilizations have failed when their means of communication proved inadequate, when he demonstrates how ponderous and clumsy some of these inadequate means of communication were, and when he demonstrates by some fine isotypes how clear picture language can be, you begin to get his point. Hogben feels that today we are in danger of being outstripped by the narrow advances of our specialists. The knowledge and judgment of the people must somehow catch up with our rapidly expanding and complex world of science. Hogben simply states that we might overcome this lag by means of the international language of pictures that "can be used to unite mankind as well as to entertain it."

JOHN R. SAUNDERS

MALE AND FEMALE

----------by Margaret Mead

William Morrow, $5.00

477 pp.

IN this book of 477 pages, the celebrated woman anthropologist undertakes to explain the physical basis of the sexes, division of labor between the sexes, the influence of parental attitudes on psychological development, and sex customs in the United States, as well as woman's proper role in human society. Much of the evidence comes from her own extensive studies of several South Sea societies. But not all. Everything is grist to Dr. Mead's mill—the advertising methods of American business, the child-rearing practices of ancient Japan, the kinds of movies produced in Hollywood, and the songs that were popular in grandfather's day.

The thesis, as I understand it, is that our society has failed to make full use of special gifts of the feminine sex and thus denied itself many benefits. By virtue of the biological differences between the sexes and between their childhood experiences, as well as differences in their reproductive experiences, women see the world in different ways than men. Dr. Mead reasons that by recognizing and cultivating the special superiorities of both sexes, a better world can be built.

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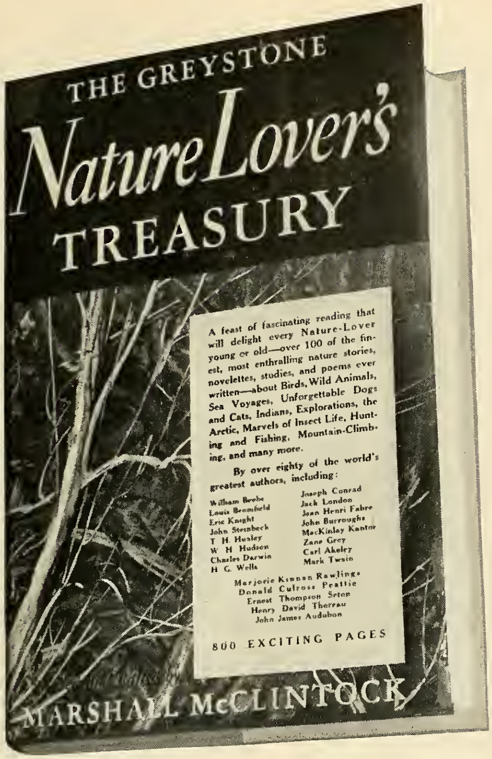
Dr. Mead embraces the currently fashionable theory of "character types" for different societies. She explains the variation in concepts of masculinity or femininity primarily in terms of the attitudes of adults toward children. Her interpretation is frankly psychoanalytical. For example, among the Arapesh a baby is treated as "a soft, vulnerable, precious little object, to be protected, fed and cherished." It is offered the breast frequently even though it may not be hungry. Never does the infant have to seize, bite, or hold the mother's nipple. Infants are carried in bark slings and have no need to grasp or hold on.

The Arapesh child grows up, therefore, with a passive, receptive attitude toward life. The female has little trouble in carrying this general attitude over into adult sexual relations. "To transfer an attitude of pleasant expectancy from mouth to vulva, of soft, optimistic retentiveness, requires very little shift in attitude." But males reared in this fashion are so lacking in habits of dominance and aggression that they fit into the role of a husband only with the greatest difficulty. They are unwarlike, easily conquered, and enslaved. Even in hunting, they reveal the effects of early childhood experience, for instead of stalking and killing game, they set traps and wait until an animal falls in.

Two points are stressed again and again in *Male and Female.* First, that the adult personality is to a large degree shaped and patterned by the child-rearing practices of the culture; and second, that the transformation from male infant to adult man usually involves a much more difficult psychological adjustment than the change from female infant to woman, regardless of the particular society involved.

Our own society, according to Dr. Mead, is suffering from emotional inflation. Our levels of aspiration so greatly exceed any possibility of actual attainment that we live in a state of chronic anxiety. This generalization applies to all phases of our lives, but Dr. Mead is here



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primarily concerned with the ways in which it affects relations between the sexes. In a chapter entitled "Can Marriage Be for Life," she points out the discrepancy between idealized "till death do us part" sentiments and the statistics on divorce and separation. It is unrealistic and unethical, according to Dr. Mead, for the State to permit any two people to marry merely because they have mutually consented to do so, and then to raise legal barriers against the dissolution of unsuccessful marital partnerships.

This book is too full of ideas to lend itself to condensation or even adequate representation in a short review. It is, first of all, a thoughtful, penetrating analysis, and the facts it contains should not be recounted except within the author's frame of reference. Nor can a reviewer label the work as "good" or "poor" and let it go at that. Too much depends upon one's willingness to accept the author's use of the facts. In the beginning of the book Dr. Mead explicitly states that she is presenting only her own point of view and that others might employ the same facts to support a different theory. This declaration does not, however, relieve her of the responsibility of discriminating for the reader between fact and intuition, between data and interpretation. And sometimes she seems to represent as factual, things that are, to say the least, open to question.

Personal reactions of a reviewer usually reflect differences or similarities between his tastes and those of the author. For example, many of the psychoanalytical interpretations in *Male and Female* strike the present writer as extreme. But in all fairness it should be added that this may represent the generalization of a negative attitude toward much that is included in the orthodox analytic point of view. A second negative reaction rests upon the feeling that Dr. Mead's literary style is unnecessarily involved and repetitious. Having stated a general point, she sometimes proceeds to particularize with one example after another until the reader becomes impatient or bored.

In the chapter entitled "Human Fatherhood Is a Social Invention"—a title, incidentally, that is apt to startle biologically-minded readers—Dr. Mead ingeniously weaves together a great deal of material to show that the human male's tendency to nurture his wife and children depends upon learning or social inheritance and is not "instinctive." The female's impulse to feed and protect her offspring is, in contrast, rooted in her biological inheritance. Several objections can be raised against this point of view. In contradiction to Dr. Mead's statement, care of the female and the young by the male is not limited to *Homo sapiens.* It appears, for instance, in lower mammals, such as certain species of mice, and in some carnivora, including wolves. Furthermore, male chimpanzees living in their natural state do protect immature members of the group. Dr. Henry Nissen has recorded instances in which the ruling male of an ape group picked up and carried to safety young animals that were threatened with danger.

In the main these are carping criticisms. As has been stated above, the meat of this book is in the ideas it contains instead of the facts it presents. The ideas are, as are all of Dr. Mead's, stimulating and instructive. Whether one quarrels with her interpretation or finds it completely adequate, no one can read her writings and fail to profit thereby.

FRANK A. BEACH

THREE WORLDS OF PERU

------------ by Frances Toor

Crown Publishers, $3.50
239 pp., 75 photos

ALTHOUGH this book is organized and written as a travel journal rather than as a conventional guide, it is likely that it will be employed from the latter point of view, and I am, therefore, criticizing it with that usage in mind. Unlike her predecessors in the field, Miss Toor covered Peru systematically in her travels, and her observations are presented in accordance with the three principal geographical regions of the country, the coast, the *sierra,* and the *montaña.* That the highlands are emphasized is only natural, since without question the high Andes hold the greatest store for the foreign visitor.

It is clear that the author, although impressed by Peru's great archaeological monuments, is far more interested in the present-day population than in the past. History and archaeology, therefore, receive no systematic treatment, which is, perhaps, as well, since Peru's colorful

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history and imposing ruins have been described time and again. The Indians, Mestizos, and Whites, on the other hand, receive considerable attention, and some aspects of the contemporary scene—especially fiestas—are described in some detail. For the benefit of the tourist a calendar of major fiestas has been included. Of particular interest, however, even to the specialist, are Miss Toor's first-hand descriptions of ceremonies and celebrations in out-of-the-way villages of the coast and highlands. But although the author appears to be a sensitive and accurate observer, her choice of informants is often uncritical, and she not infrequently goes astray in the matter of interpretation.

In spite of a number of irritating errors, however, each region of Peru is characterized with surprising accuracy and with attention to its special flavor and feeling tone. It is a pleasure to read a travel book by one who so honestly liked, sympathized with, and appreciated the country and the people.

Harry Tschopik, Jr.

TROPICAL AQUARIUMS

by Ian Harman

Illustrations by Humphrey Dakeyne

Sidgwick & Jackson Ltd., London, 10/6
168 pp., 54 drawings

THE tropical fish fancy has engendered its share of books purporting to explain the intricacies of tank management to the novice and the refinements of aquarium practice to the more experienced amateur. None of these has been completely successful, however, largely, we believe, because they have devoted too much space and effort to uncorrelated facts and not enough to the principles underlying the proper maintenance of small fishes in captivity. Not that the fancier needs, or wants, a book on the physiology or ecology of his pets! He does need, however, a general, more or less basic knowledge of the part played by the water, sand, plants, appurtenances, fishes, and other life in his aquarium. No author can hope to cover even a fraction of the exigencies that can arise—situations that can only be met by applying properly understood principles.

This book suffers from the same defects as its predecessors; not enough is said in its introductory chapters on how to set up and operate a tank. What *is* said is in general accurate enough. We might quarrel with the advice given to feed one's fishes several times a day, although this is good practice if minuscule enough amounts are given each time to avoid overfeeding. In common with the great majority of aquarists the author misunderstands the functions of plants in aquaria, believing that they serve to oxygenate the water.

The American aquarist will be interested in the contrivances upon which the austerity-ridden British fancier must depend for heat, light, and aeration, and will consider himself fortunate in having both the mechanical devices and the power to run them readily at his disposal.

James W. Atz

THE AWL-BIRDS

by J. K. Stanford

The Devin-Adair Company, $2.00
90 pp., 28 illusts.

IN the populous home island of the British not a few species of birds have disappeared as a result of mistaken activities by gamekeepers, the draining of marshlands, and other pressures of human occupation. One of the birds that recently came back from the Continent to nest in England after more than a century is the graceful avocet, a shorebird with a thin upcurved bill like a cobbler's awl.

There was grave danger that "British-taken" avocet eggs would tempt covetous oölogists; hence special efforts were made to guard their nests. This much is fact. Mr. Stanford has dramatized the story and woven in many incidents typical of postwar Britain. The precious eggs, on the point of hatching, are saved from a predatory collector, and retribution comes upon the villain in appropriate but unexpected fashion. The tale is well conceived to arouse fervor for the protection of rare birds. Mr. Hughes's pen-and-ink sketches are an admirable complement.

James P. Chapin

THE INDIANS OF THE SOUTHWEST

A Century of Development Under the United States

by Edward Everett Dale

University of Oklahoma Press, $4.00
283 pp., 16 plates, 5 maps

THIS book deals with an important and neglected aspect of United States history—the relations of the Federal Government with the Indians inhabiting that vast territory acquired by treaty from Mexico in 1848. It is a bitter history and, until very recently, one of broken pledges, shameful neglect, maladministration, and bloody warfare. The area covered extends from central New Mexico to central and southern California, once a wilderness of deserts and mountains peopled by Indian tribes of widely differing cultures.

Friends of the Indian, the author contends, are often prone to condemn the Indian Bureau, particularly during its formative years, for bungling and mismanagement. He shows, however, that in many instances—as during the gold boom in California—ineffective handling of Indian affairs must be blamed on the inherent difficulties of the task rather than upon any lack of good intentions.

In his eagerness to be fair, Mr. Dale speaks repeatedly of "definite objectives" and "established policy" of the government when discussing Indian administration from Grant's presidency to the early twentieth century. Yet any clear-cut aims and goals during this period are difficult to perceive. The plight of the landless Mission Indians was virtually ignored until cries from the California press made action inevitable, while Navaho and Pueblo administration was characterized by quarrels between military and civil officials and by graft and corruption on the part of political appointees.

Although the history is detailed and meticulous, it is history in the narrow sense, unrelieved by any deep understanding of the Indian cultures involved. Current problems are discussed almost exclusively from the administrative point of view, while pertinent recent literature on the Indians' attitudes and adjustments has been completely ignored. The author has, however, done an excellent job of assembling and editing important and inaccessible data from government archives, newspapers, and unpublished manuscripts.

Harry Tschopik, Jr.

16MM SOUND MOTION PICTURES

by W. H. Offenhauser, Jr.

Interscience Publishers, $10.00
580 pp., 123 figs.

THOSE who are graduating beyond the usual 16mm motion picture camera to full sound moving picture equipment will be interested in this new book. It answers almost every conceivable question on the use of the various types of equipment and on the technical processes involved in the production of the finished film.—Ed.

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Exploring and collecting in mountains and canyons with young naturalists, journalists, and photographers. Staff known in school, camp, and museum circles. 22nd summer. Prospectus available.
Interviewing candidates February 5-11, Hotel Roosevelt, New York City.

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THE COMMUNITY SCHOOL
900 Lay Road, St. Louis 24, Missouri

➤ **Princess Te Puea** and your author on the steps of the meetinghouse at Ngaruawahia Pa

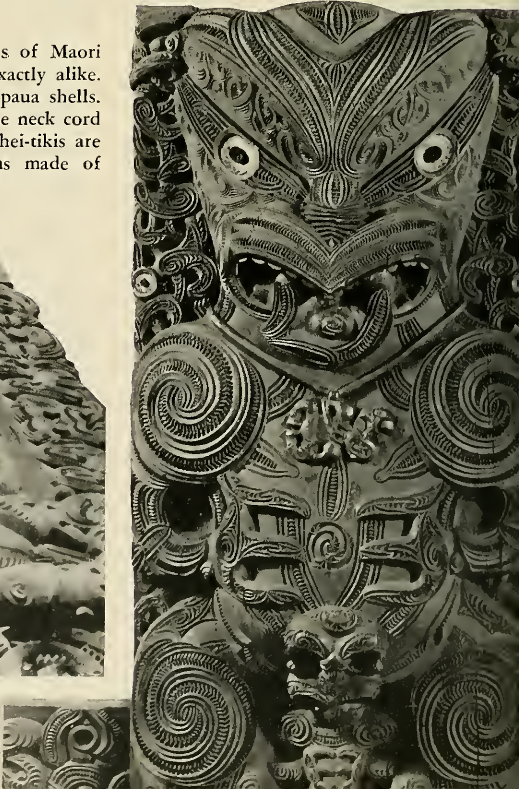
The Maori

The enormous stretches of the Pacific Ocean are becoming more and more of a laboratory for scientific research, due in large measure to the Pacific Science Congresses, which have been meeting in its various parts. Roughly spaced at three-year intervals, except for a longer war interruption, seven have now been held, in Hawaii, Australia, Japan, Java, British Columbia, California, and in 1949, New Zealand. The Eighth Pacific Science Congress will meet in the Philippines. The work that has been accomplished is tremendous and has led to far-reaching programs for current and future study.

All branches of science are included: zoology, oceanography, every kind of medical work, fisheries, agriculture and conservation, education, and more. The subject of anthropology could not fail to win

➤ **There are many** new Maori meetinghouses. The carving, by old men who know their trade, adheres strictly to traditional rules

➤ **No two panels** of Maori carving are ever exactly alike. Eyes are made of paua shells. The pendant on the neck cord is a hei-tiki. Such hei-tikis are treasured heirlooms made of greenstone



Photos courtesy New Zealand Legation

Were Our Hosts

An unusual visit with the natives of New Zealand —an ancient and noble people whose cultural rebirth has won them world-wide respect

By Grace E. Barstow Murphy

Photographs by Athelstan Spilhaus
unless otherwise credited

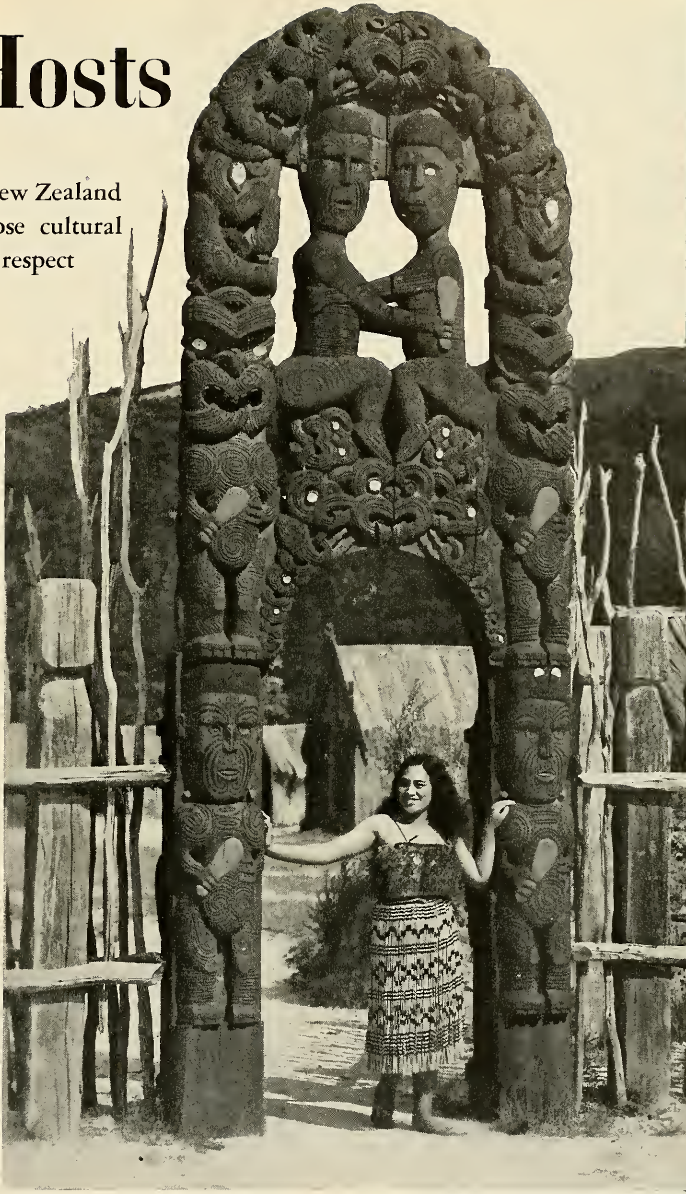


Photo courtesy New Zealand Legation

▲ One of our Rotorua friends. Each of the ancestral weapons on the gate carvings is called a "mere"

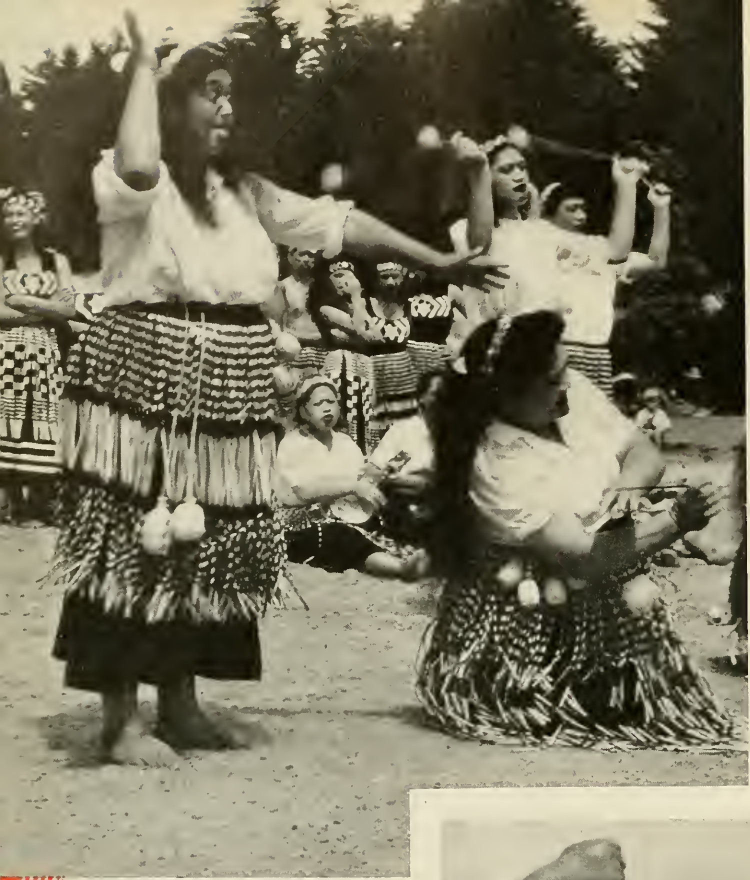
particular interest, because the Pacific peoples from Hawaii to New Guinea fascinate everyone who thinks about them.

Modern anthropology has a new approach. The world's foremost anthropologists no longer treat the native like a butterfly on a pin or a squirrel in a cage. Rather, he is treated as a friend, and it is considered a privilege to approach him and to learn his way of life. That spirit prevailed at the sessions of the Congress that I attended in my capacity as delegate. I have never known livelier scientific discussion than that among the anthropological scholars of a score or more of nationalities gathered first in Auckland for a week and later in Christchurch for a second session.

In between these sessions, the various groups of scientific folk were sent traveling by the Government of New Zealand. Big, comfortable buses were supplied each group, each with a leader to keep us informed, follow the itinerary, and arrange for our comfort. It was science, but it was holiday. Holiday for scientific people generally means more science in a different garb.

The focal point of our eight-day anthropological tour lay in the person of Sir Peter Buck, who had come home after many years away. He is half Maori. He grew up among the Maoris like any other Maori boy. However, he went much further, after his graduation from college, than do most boys of any race. He became a full professor at Yale, without doubt the only one whose grandfather belonged to a cannibal tribe. He has held for many years the directorship of the great Bishop Museum in Honolulu. He is the most noted ethnologist in the study of Pacific peoples.

But in New Zealand, he is the loved member of his race. At mention of his name, Te Rangi Hiroa, to any Maori, smiles of pride and deep affection break forth. I have seen it happen many, many times. In his visit of 1949, he was the son, the brother, the father, of every Maori in New Zealand. Which, of course, meant fatted calves and cel-



▲ A JESTING DANCE with the long poi. Judging from the facial expressions, the singing in Maori is probably full of fun. Note the difference between the long poi and the short poi fastened at the belts of the flax skirts

ebrations. He must have visited nearly all the villages. As hospitality is part of education in Maori culture, the entertainment was superb. We pakehas, as the Maoris call our race, Sir Peter's friends and colleagues, were included. In village after village, dancing, feasting, speech-making, welcomed him, and us.

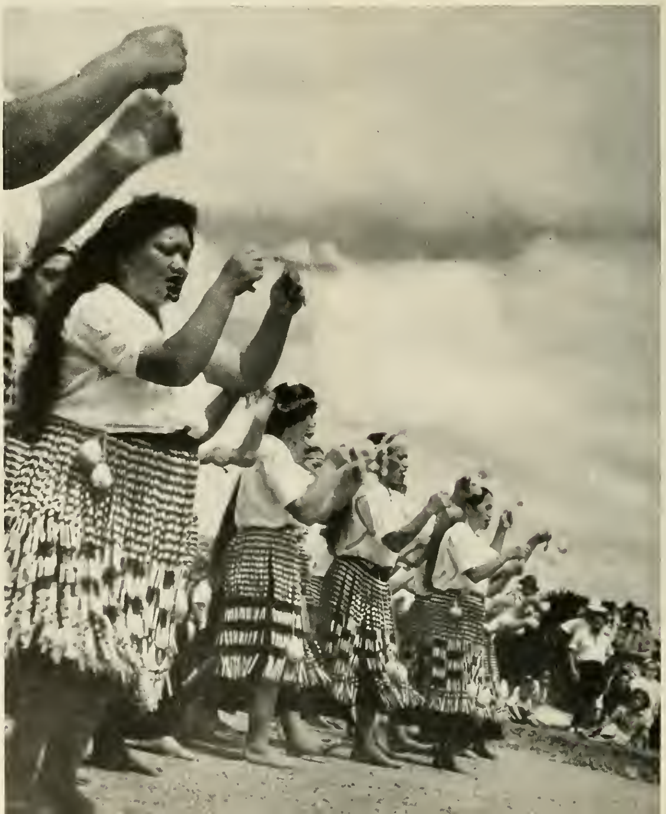
In each pa, the procedure and settings differed sufficiently to keep one's interest very alert, but the pattern was the same.

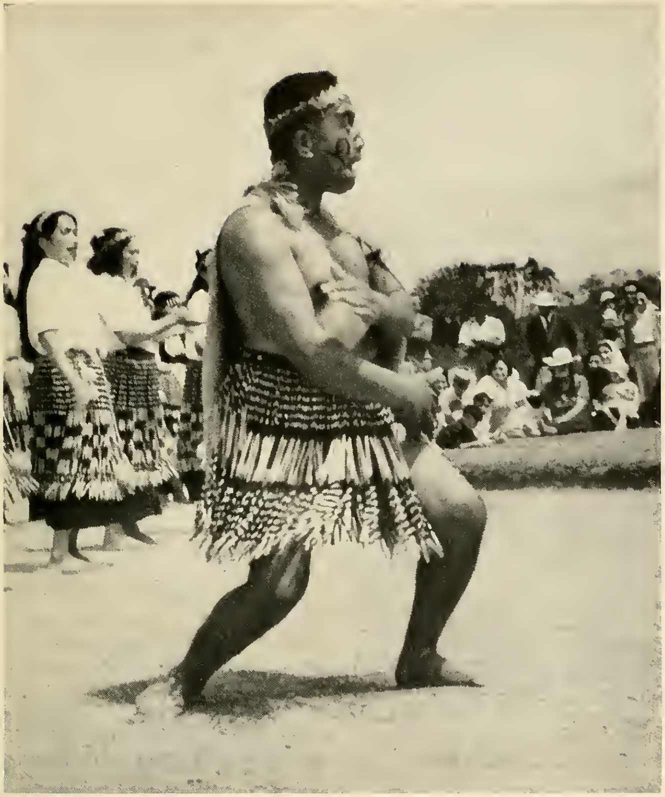
I use the word "pa" advisedly. In the old days, pa meant a fortified village, with an intricate system of ditches and barricades, often arranged on a hilltop. *Kainga* was the word for an unfortified village. Today, long after the time of need for such fortifications, many scholars use the word "pa" for the usual Maori village, of which there are hundreds in New Zealand.

Our party reached the first village, Ngaruawahia, at about eleven of a warm, sunny, midsummer, February morning. There were over twenty of us, three women and the others men. We were all excited at the unusual chance to enter into tribal customs practiced over centuries, to see such dances and share in such feasts.

We gathered outside the carved arched gateway, flanked with beds of brilliant flowers. The red ochre on the carving keeps troublesome forest spirits outside where they be-

▼ POI BALLS FLY in perfect synchronization. Only the old women in the villages have real tattooing on the chin and lips, but this woman has painted an old design on hers. Stout women are as light on their feet as girls





▲ **Facial contortions** are an important part of Maori posture dancing. Tongues shoot out incredibly, and the whites of the eyes are made to look enormous. The old war dances were extremely terrifying

long. Every custom of the Maoris has some such explanation.

Against the mountains that are always the backdrop of New Zealand scenes, we could see inside on the village green a gleaming group of brown, half-naked warriors.

A chief detached himself and dashed toward us, brandishing a long and slender weapon, leaping, yelling, making faces, tongue out in defiance, eyes rolling. It was fearful. I almost ran. He was naked except for the swishing flax skirt that he wore over shorts.

He stopped in time. His anger turned to courteous pleasure. He began to lead us in. Again he whirled upon us, driving us back with his ancestral weapon, grimacing furiously. Again he turned and led us in. He joined the group of warriors. They did a leaping dance of welcome.

The feathered, spearlike club carried in this dance is a taiaha, used both ceremoniously and in actual fighting. Its technique was taught as carefully as that of sword or foil. Training in arms was ceaseless with the Maoris. A beginner learned to watch fixedly the big toe or the shoulder point of the adversary. The toe clenched downward, the shoulder showed a muscle movement a split second before a blow was to be delivered. The dance-trained warrior, never standing still, agile and light on feet, could leap aside. It is reported that when firearms came in, a Maori could sometimes dodge a bullet by a quick movement at the flash of the gun.

When the men finished their lively welcome, the mood changed, and the old women of the tribe, waving wreaths of leaves and branches, danced a tangi for the dead. We stood silently and quietly, our heads bowed. It must be pleasant to know that one will always be remembered, in affection, in one's Maori home.

After that short seriousness, everything was gay. We were led to benches on one side of the marae, or open space before the meeting-house, sitting in the sun at right angles to the porch that sheltered Sir Peter and his Lady. Our hosts sat opposite. Sir Peter sent for me, and I sat near him, more comfortable in shade. As soon as one dance stopped, another started. Nearly all were posture dances, called the haka. Their ability to express their ideas in motion is so great that one could almost

▼ **The red ochre paint** of the carved gates of the villages keeps out evil spirits. We would stand waiting till ushered in by dancers. The significance of the three-fingered hand is lost in the past. The protruding tongue symbolizes defiance

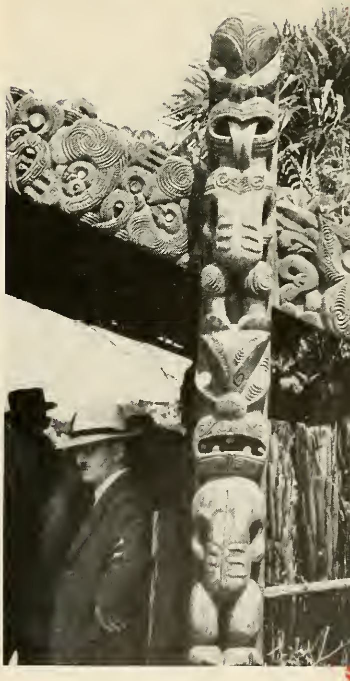


Photo courtesy New Zealand Legation

▲ Sir Peter Buck with the Governor-General, Sir Bernard Freyberg, V.C., at Government House, Wellington, on the occasion when Sir Peter was invested with the insignia K.C.M.G.

follow the meaning of the singing even though it was in soft-toned Maori. The men knelt on one knee, weapons on the ground, while the women came toward us in the perfect synchronization of their dancing. Rhythm flowed throughout their bodies, hands and feet, and all their muscles. Fingers added movement in a lovely grace.

The poi dances are done with two flax balls on a six- or eight-inch string, one in either hand. The dance called the long poi uses balls with strings perhaps two feet long. Whichever length is in use, the balls move in absolute precision and at lightning speed, over the shoulders, under the arms, crossed, uncrossed, in a maze of figures followed in accuracy by long lines of dancers. They are taught, of course, from childhood. A mistake made in the dance is traditionally bad luck. Their carefree, happy natures find outlet in this dancing. The older women join the young, full of fun and nonsense, light as air in spite of heavy pounds. Everybody dances, but the rules and patterns are followed in accepted discipline.

Each flax skirt takes months to make. The men's end above the knees, but the women's fall generally to the ankles, over full skirts. Nearly all wear headbands, often with feathers in them, their long black hair flying loose. The women's bodices are often bright with embroidered bands. At the Rotorua celebration a few days later, the costumes, though still Maori, were influenced by our modern stage. Skirts were short, and more emphasis was laid on color.

The designs of the skirts are dyed onto the flax. The parts to be colored are scraped, the rest left natural. The strands are soaked in a bark infusion and then buried in black mud, which stains the scraped parts. The sound of the fibers is delightful as the dancers move.

One leader of the women wore a feather robe—undoubtedly a treasured heirloom. The Maoris have never done weaving as we know it. They made material for clothes by finger-weaving strands of flax. In the feather cloaks, each feather was tied in place by hand. When one hears careless modern whites call the Maoris lazy, one wants to recommend a course of reading. Until the early settlers came, they had no time for laziness. They had to work hard.

When they arrived from hotter climates 600 years ago, their whole culture had to be readjusted to lower temperatures. They found New Zealand flax, tried out the different kinds, chose one, grew it with care, and learned to make their clothes. They had as hard a job with food. The tropical plants brought with them in their great canoes, such as breadfruit, would not grow in New Zealand. Only the *kumara,* or sweet potato, survived easily. Some taro grows in the North Island. They learned which native ferns were good to eat. They worked out a laborious system of agriculture. They had 27 names for 27 different kinds of soil. They learned the ways of unfamiliar birds and fishes and how to catch and preserve them. They became experts in everything they attempted. And life was dedicated to their art to such extent one wonders how their years were long enough to complete their work. Every war canoe was carved from end to end, taking years to build. The task of felling enormous trees with basalt and greenstone tools seems an impossible one.

That the Maoris lived in the Stone Age, like most Pacific peoples, knowing no metal until the beginning of the last century, seems to me to make their story one of the most surprising records in history. Metal has been taken for granted for so long throughout nearly all the world. To them, "greenstone" meant what "golden" does to us—a word carrying the thought of something precious: "a golden opportunity," the "greenstone door" to everlasting peace. Greenstone is a jade almost as hard as steel. Its discovery in New Zealand was a rich one for the Maoris. Yet how they worked it into smooth, sharp, symmetrical tools, weapons, and ornaments, sometimes with carving on them, is one of the wonders of human attainment. Dr. Skinner, Director of the Otago Museum in Dunedin, spent hours of his busy days showing me the vast collections of the Maori greenstone. Many dancers wear greenstone tikis as jeweled ornaments, hanging from cords around the neck. They are shaped somewhat like human embryos. The significance of some of these things is lost in hazy history, as the Maoris had no writing of any sort for keeping records.

Such thoughts played through my mind as I watched the rhythm and infinite grace of the dancing, while a tiny child wandered about the marae, climbed up onto the porch, then onto Sir Peter's knee.

⮝ THE SWISH of the flax skirt makes a lovely sound to accompany the soft singing. This man's face is painted to look like "moko," or tattooing

The dancing stopped. Speeches began. Through all the centuries, speeches made on the marae have been a most important part of Maori life. All the Maoris are orators. Their flowing, flowery language serves such purpose well. It is a Polynesian dialect, similar to Hawaiian and Tahitian. The speakers were wearing ordinary clothes. Each speech was translated, then answered by one of our own party. Sir Peter grew rapt in Maori, more casual in English. He told his people that though he had been away, he had worked throughout the years on Maori matters. He thanked them for their welcome. At one pa, he fell exuberantly into some haka steps. The speakers extolled his Lady for the support she had given him. They extolled the scientific folk in words that sometimes ran: "We always welcome the Government people. They are our contact with the outside world. It is to them we must offer our thanks for this opportunity of greeting the scientists . . . You, as our guests, represent to us our forebears who have departed. You were with our sons at the first World War and are instrumental in bringing with them peace to the world . . . Pakeha education has been felt in this district. May the scientists leave something of use to the Maori . . . Bring with you the baskets of knowledge from Io . . . You from the many islands of the Pacific and continents of the world, we are asking ourselves the reason for your visit to our district . . . Welcome to New Zealand! Welcome, and bring the knowledge from those places from which you come and share it with us. Our people have helped the world. You see their record. Welcome, good health and prosperity."

Our Dr. Ryerson, Chairman of our American delegation to the Congress, was charming in his handling of our thanks and tributes. The Fijian, Dutch, Indonesian, French, Australian, New Zealand scientists of our party, and the other Americans also caught the spirit of the friendly Maoris.

The many speeches finally over, our hosts lined up, and we passed by them, shaking hands. We entered the meetinghouse through the carved door.

I later went into many beautifully carved meetinghouses where there was no furniture at all beyond a few mats or mattresses on the floor. Originally, Maoris never had furniture. But in this one, envisioned by

Photo courtesy New Zealand Legation

➤ THE PAINFUL APPLICATION OF "MOKO," a custom taught to Maoris by their gods in dim history and followed till recent times the Princess, Te Puea, who was about to join us, deep chairs and sofas, flower-covered tables and rugs, invited us to comfort for as long as we could stay. Taste and style were flawless. The arrangements were more homelike than is usually found in a room 80 feet long. The walls and rafters followed the intricate order of Maori architecture and design, with the one difference that there were many windows. Panels of woven flax in color separated the great carved panels, each of which differed from the other, yet all were similar in plan. Brilliant design in red, black, and white decorated the rafters. The long ridgepole was carved. Feather cloaks hung on the walls with ancestral weapons, and grass skirts served as curtains. The far end was blocked off as a small and very choice display of treasures.

As the Princess joined us among these colorful, luxurious appointments, we rose as a body to greet her.

She wore a bright-flowered calico blouse, which hung outside her long, black cotton skirt. She walked erect on the bare feet that have carried her forward, inspired by her vision, to a leadership of the Maori race. A black scarf half covered her soft white hair, accenting her wide mouth, large well-set brown eyes under strong brows, and her shapely nose and chin.

She had just been eulogized in speeches on the marae as the outstanding Maori of her age and generation. Her people had been disintegrated and disheartened. In her vision she was told to mold them together again, never giving up her goal.

She walked slowly, for she is not well. There was no pomp and circumstance of royal birth and no sign to separate her from the scores of brown-skinned Maoris with us in the whare runanga. No sign, did I say? There was a strength and knowledge of living in her face which should go with every such title as the Princess bears. To her sympathetic understanding, credit is given for the slow and difficult adjustment of the Maori to the pakeha world. She is called a striking example of what influential Maori leadership can be and what it can accomplish. A lesser race than hers would long ago have knuckled under to the impact of foreign aggression. There is intellect in the Maoris. Their system of communal living, coupled with an aristocracy, all without any economic striving, stressed and developed mental qualities.

Their ancient schools, called whare wananga, attended by the first men of the tribes, trained them in philosophy, religion, ritual, tapu. Their mythopoetic lore holds as great a sensitiveness to life and beauty as can be found in that of any race. Though they had no form of writing, their memories were trained to prodigious capacity. White men alive today have heard old Maoris chant 1400 names and stations of their ancestors. No mistake was permitted.

With such a history of minds revered and trained, it was not strange that the Young Maori Party arose out of the general disintegration of the race, a few decades ago. Men like Sir Ngata Apirana, Sir Peter Buck, and others joined together to block the downward path toward complete destruction. Population decrease stopped. Increase began. Hope awakened. These modern Maori intellectuals are educated in Te Aute College. It is hardly possible for untrained Europeans or Americans to comprehend the racial habits and the needs of so different a culture. In the educated Maoris there is combined an understanding of the best in both the races, whose difficult relations in New Zealand have always been colored by a mutual respect. It is significant that in 1948 the name of the government's Department of Native Affairs was changed to the Department of Maori Affairs. None of this means that problems are solved. There is still disease and poverty, bad housing, and bad feeling over land. It means, however, that the best men of both races are working toward well-chosen goals. It means that the time was ripe for good work to be accomplished by the Princess. She taught her people that they could not live in the memory of wrongs. She modified their attitude toward the Government in such matters as the Waikato land development schemes, teaching co-operation and its value. "Work with the Government, not against it," was the wisdom that she taught. She has raised money for homes for orphans and landless people in her own village, Ngaruawahia. The beauty of her village is due to her planning.

In 1925, Elsdon Best in his book, *The Maori*, wrote of the decadence of Maori art. In 1940, Professor I. L. G. Sutherland, who edited the compilation of papers called *The Maori People Today*, recorded the revival of Maori arts and crafts. These two books alone, both out of print but available in libraries, give a well-rounded understanding for those curious to know something of the situation.

The room that held us proved Te Puea's conviction that it is possible to unite modern comfort with Maori tradition and background. Housing is notoriously bad among the Maoris. She had four-room houses built, combining Maori materials, style, and construction with pakeha sanitation, at a quarter of the cost of a pakeha house. She knows what is essential to the Maori's culture and what are the demands of his different background. She knows his pride of race and his requirement of a communal existence, combined with an aristocracy of tribal chiefs. She knows his need of art, of humor, and of dancing, his mythopoetic lore and his pride of ancestry. She also knows his need of the benefits of white civilization. The upper class of Maoris from earliest times saw little difference between the cult of their Supreme Being, Io of the Hidden Face, and the doctrines of the missionaries. By means of such clear-eyed vision today as theirs was then, the race is being led to new confidence and attainment.

Generally, the meetinghouses consist of only one room. Te Puea's has several rooms, including a modern suite with bath, for guests.

We passed through to a dining room where lace-covered tables groaned under five times as much

Continued on page 48

HOME AGAIN: Canada Geese in flight formation over the Gaddy sanctuary

BACK-YARD Bird Sanctuary

The unique achievement of Lockhart Gaddy attracts thousands of visitors every season and shows that the greatest satisfaction lies in working *for* nature, not *against* it

By EDWIN D. NEFF

Photographs by HUGO H. SCHRODER

LOCKHART GADDY used to be a hunter.

Now he refuses to hunt.

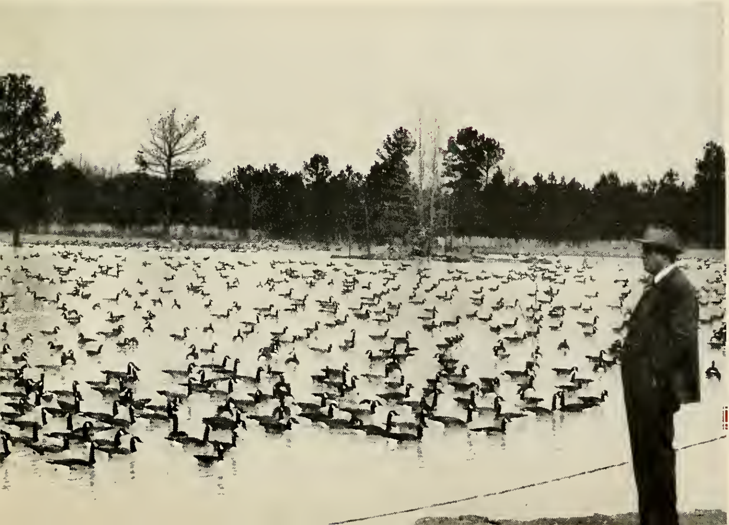
He used to lie behind the cold, damp blinds of the Carolina marshes, gun in hand, waiting for the cry of the great gray geese sailing high across the moon. Later, if he was lucky, the Gaddys would dine on succulent roast goose flooded with rich goose gravy.

Now Lockhart Gaddy and his wife cannot abide roast goose. Yet less than an hour's walk from their farm near Ansonville, North Carolina, thousands of fat Canada geese paddle smugly about a great pond from October till March. Further, the Gaddys are feeding the geese these days!

Mr. Gaddy, you might say, has got a kind of religion. He no longer belongs to those bands of "sportsmen" who prefer to study Nature through a gunsight. Instead of hunting geese, he protects them. He has built the most unusual wild goose refuge to be found anywhere in the United States. It is known to bird lovers and the public throughout this country and in many foreign lands. Needless to say, the Lockhart Gaddy refuge has a wide reputation among geese.

That Mr. Gaddy's change of view came about accidentally is none the less to his credit. The fact remains that he is now a sensationally successful conservationist and is inspiring others to follow in his steps. Already, a neighbor has built a small goose refuge.

The state of North Carolina has given legal recognition to the Gaddy sanctuary, and hunters are forbidden within a half mile of the little spring-fed lake which Gaddy himself built and has twice enlarged.



◄ SINCE LOCKHART GADDY put away his shotgun in 1934, his little lake has become increasingly popular to wintering birds, and the world has stamped a beaten path to his door. Naturalists and camera fans have an unusual opportunity to study the birds at close range

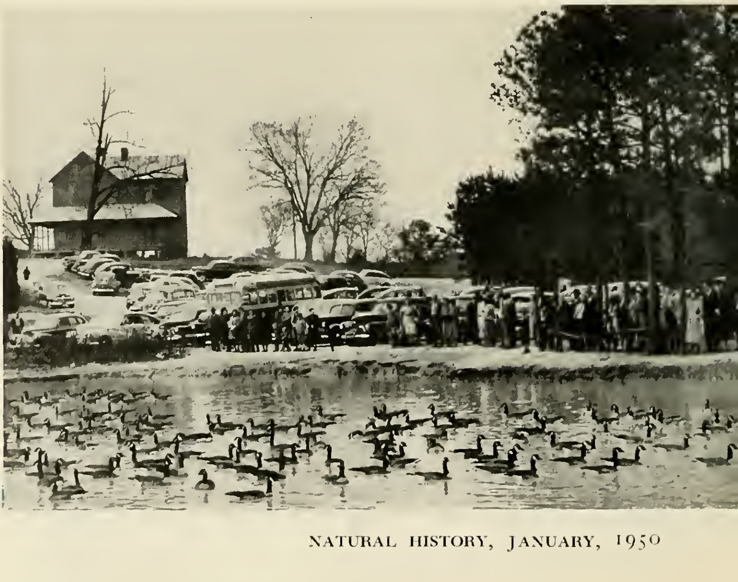
➤ Close-up of two Canada Geese, one well out of the water

Gaddy's place is gathering a kind of fame as well as spreading the gospel of conservation. Thousands of visitors pour in over week ends and gladly pay for the rare wonder of seeing wild geese no farther away than you can throw an ear of corn. Mr. Gaddy makes little money on his admission charge of 25¢, because the geese eat 1200 to 1500 bushels of corn in a season.

This, then, is the story of what a single individual has done, even in these times of hustle and bustle, to bring the pageant of Nature to his doorstep.

The story begins nearly fifteen years ago, when Mrs. Gaddy's mother, Mrs. Pattie K. Ross, who loved to fish, suffered failing eyesight. It was no longer safe for her to fish the tricky current of near-by rivers, so Mr. Gaddy built a one-acre pond on his farm. Also using the pond were a number of tame geese, which Gaddy had used as live decoys in the days when the law permitted. Though these creatures had long since become corrupted by the easy life around the farm, they still echoed their age-old cry when wild geese were flying overhead.

One autumn day, Mr. Gaddy was surprised to discover that his decoys had called down nine wild Canada geese to the tiny fish pond. The wild ones decided to stay instead of moving south with the flocks, and actually remained all



➤ As many as 3000 visitors come to the Gaddy refuge on a Sunday. This singular spot is an urgent attraction to every nature-minded traveler on his way through North Carolina winter. At first, of course, they zoomed off every time Gaddy got near the pond. They wouldn't touch the shelled corn he left for them. Finally, they came to accept corn on the cob, but only if the ears were mashed into the ground. Two months passed before the wild geese would allow Gaddy to approach the pond while they were around, and even then they remained on the opposite shore. That was in the fall of 1934.

The following year, the Gaddys found themselves glancing hopefully toward the sky every time a flock of geese passed by. Imagine their delight when 35 Canada geese suddenly detached themselves from formation and swooped down to the pond. The new winter visitors, however, were just as wary as the first nine. Whenever anyone approached the pond, they flew off or scuttled to the other side.

The third year the goose population of Gaddy's little pond rose to more than 100, and by the following year, nearly 500. The early comers must have inspired confidence, because the new birds were much more tolerant. They accepted food graciously and allowed themselves to be approached within a reasonable distance. From then on, the flocks increased every year, arriving by the first full moon in October and remaining until the first full moon in March. During the 1946-47 season, nearly 6000 of the great gray honkers were demanding reservations. The following summer, the number had leveled off a bit, but Mr. Gaddy expects the average to become about 6000 per season. During these years the number of human visitors to Gaddy's astonishing sanctuary also had increased, until now anywhere from 1500 on a bad-weather Sunday to twice that number in good weather can be counted on. Several hundred appear on weekdays. All this is small wonder, for the Gaddy pond is a photographer's paradise.

All varieties of flight shots are possible from close range. When a sudden movement startles the birds off the pond, a speed shot will record wings in every flying position. Groups of birds leaving shore can be snapped with tails toward the camera, displaying the prominent white markings seldom seen by the casual observer. Flocks coming in from foraging expeditions often stunt, performing sideslips, rolls, and all manner of aerial acrobatics.

As the little pond began to attract larger numbers of geese, Mr. Gaddy began to be troubled by shotgun artists, as well as cameramen. The huge concentration of geese drew hunters from all parts of the state, threatening the birds with mass slaughter whenever they left the pond. Finally, the State Legislature was persuaded to close the area to hunters within a half mile of the pond. This gave the birds a chance to gain a fairly safe altitude on the take-off before passing over dangerous country.

On moonlight nights, the wild geese leave the pond for distant feeding grounds, returning just before daybreak. When clouds obscure the moon, they wait until dawn for their flights.

They are still wary. Wild Canada geese are intelligent and will note the slightest change in their environment. If a visitor approaches from the pine woods instead of from the path leading to the Gaddy farmhouse, they become alarmed. Then the usual goose *yakity-yak* changes to a fearful cackle. If the visitor behaves himself and avoids sudden motions, however, the talk returns to conversational tone.

Once, a photographer who had been using a small camera switched to a large type which required a tripod. Instantly, the geese became suspicious and moved offshore. But within about a half hour they had decided the new gadget was harmless and began to move about freely once more. They have become quite friendly with the Gaddys, however, and will approach to within eight to ten feet. A visitor who is accompanied to the pond by Gaddy gets a much better reception than if he comes alone.

While Canada geese are by far the most numerous wildfowl on the Gaddy refuge, other species are seen from time to time. Several White-fronted and Snow Geese

➤ Most of the avian visitors are Canada Geese, but many other birds can be seen here, including some that are rarely observed in this part of the country

◄ Because protection is given the wild birds, they enjoy perfect confidence in their surroundings—until a strange dog or some unaccustomed activity sends them flying

have been observed, as well as Hutchins's Geese. Nine Blue Geese had arrived by October 29 last fall.

Various ducks winter with the geese. The Gaddys have seen Black Ducks, Ringnecks, Mallards, Shovelers, Redheads, Green-winged Teals, Pintails, Baldpates, Canvasbacks, Ruddy Ducks, Blue-winged Teals, Coots, and Grebes. But perhaps most astonishing, because only one other example appears to have been reported from North Carolina, was a Cinnamon Teal, a western bird, whose presence was vouched for by two competent bird students besides Mr. Gaddy.

During the past season, records have been broken. The first geese—a group of seventeen—arrived earlier than ever before, on September 22. By October 29 an estimated 3000 had arrived—the largest number ever to have gathered during October. By November 21, there were at least 5000.

One Barnacle Goose, a European bird, came last November. Dr. Broley, the famous eagle bander, who also vouched for its identity, stated that it was the first one he had ever seen in all his travels.

Shortly after Gaddy saw that his pond was definitely established on the Canada's Duncan Hines list, the U. S. Fish and Wildlife Service set up a banding cage at one end of the pond. As many as 100 geese have been trapped for banding at one time. Nearly 500 of them were banded in one season. Many of these geese at the Gaddy pond have been found wearing bands of the Jack Miner Sanctuary in Kingsville, Ontario.

Gaddy tells a story of banding a number of geese on January 12, 1945, after which some of the birds, still terrified, took flight. Four days later, two of the banded birds were shot in southern Illinois, 500 miles away. (Canada geese in flight average 30 to 50 miles per hour.) This was curious, not only because of the distance but because of the direction. The unfortunate geese had traveled 500 miles westward at a time of the year when they were supposed to be permanently settled in the wintering areas.

During the banding operations the geese were weighed and found

➤ Some of the geese weigh as much as 11¾ pounds. They eat 1200 to 1500 bushels of corn in a season

▲ **When the birds leave** in March, a quiet descends over the Gaddy farm, but there is always excitement preparing for next season's winged pageant

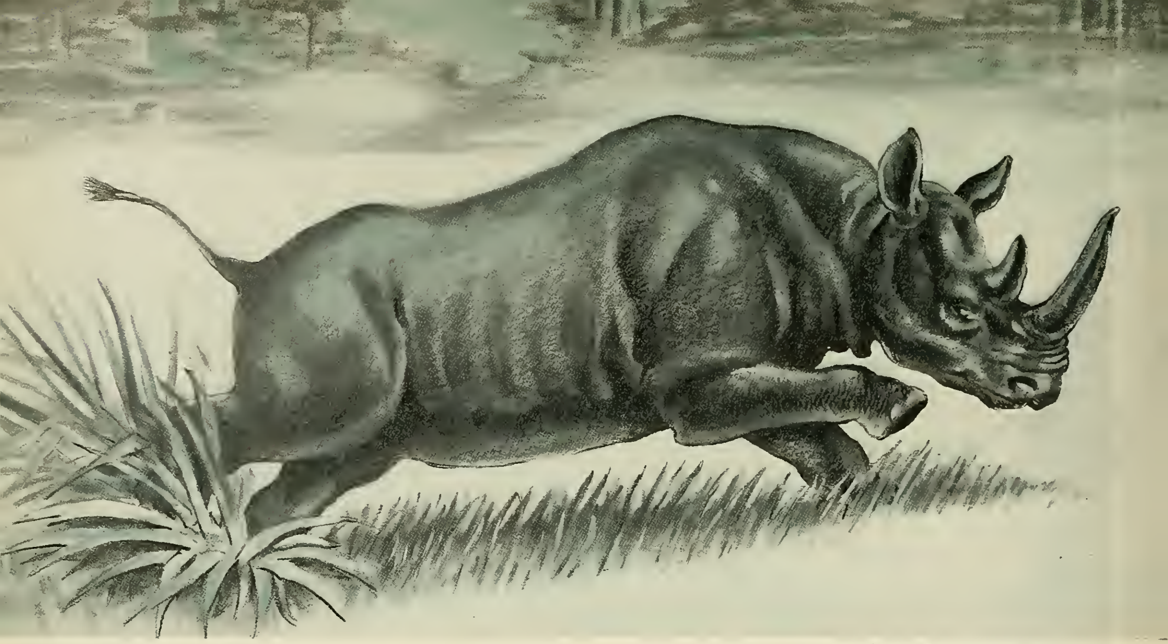
to average 9½ pounds, though some weighed as little as 6½ and others as high as 11¾. Geese are apt to be belligerent when nesting. The nesting goose will allow a strange human to approach only so far; then it charges, hissing like a snake.

There are, of course, sanctuaries where Canada geese gather in much greater numbers than at the Gaddy farm, but the birds can be seen only through binoculars, and photography is difficult or impossible. At Gaddy's all the birds are concentrated in a three-acre area. The farthest birds are only a few hundred yards distant.

This no doubt accounts for the sanctuary's popularity. Visitors include school children, college students, bird-study groups, writers, photographers, conservationists, ministers, and even hunters who, of course, are minus guns. Some stay only an hour or two, others bring picnic lunches and make a day of it. They learn more in a day of close-range observation than they could in a week of watching the birds from a distance.

Both Mr. and Mrs. Gaddy visit their pond twice daily, though it is a mile and a half from the house. As we noted, they have long since lost interest in roast goose. They look upon these wild birds as their children. They eagerly await their arrival in the fall, and in spring they remain at the pond until dusk to say "good-by" to the restless birds.

When March has passed, there is a deep quiet over the Gaddy farm. The pond is empty except for a few crippled birds and descendants of the original decoys. A kind of sadness descends. The days drag until October when the geese return. But Mr. Gaddy has something to look forward to that is more exciting than his shotgun and hip boots. He finds greater satisfaction in having won the friendship of these majestic birds of passage.



Drawing by Museum Illustrators Corps

MONSTER of the Mist Forests

A heavy pause, a violent snort, a sudden turn, and the massive African black rhinoceros charged through the brush, downing everything in its path. Here, indeed, was nature's counterpart of the Sherman tank

By KEN STOTT, JR.

General Curator, Zoological Gardens of San Diego

TANGLED forests clinging closely to the contours of mist-shrouded slopes; ravines of blood-red rock; filmy plumes of water plunging into foaming and tortuous stream beds — this was the stronghold of the monster of the mist forests.

While I waited still and motionless, the guttural chuckle of a colobus monkey echoed through the jungle, and intermittently the throbbing call of a touraco emanated from some hidden perch. From the distance came the sound of the breaking of brush and the muted trumpeting of an elephant. Night was enveloping the East African forest with the rapidity that is typical of the passing of equatorial dusks and dawns.

Suddenly, from up the trail, muffled footsteps advanced, sucking and sloshing in the ooze. A blustering wheeze of uncertainty rent the air. Then a heavy form detached itself from the forest and the increasing gloom.

As it stepped into the clearing, four yards of massive, wrinkled power and two menacing horns became apparent. This was the monster himself—the African black rhinoceros!

Once he had emerged from the forest, he broke into a swaggering trot and made his way to the water-hole with all the grace of a Sherman tank. He stopped on the bank and lifted his head to sniff the air cautiously. Eventually satisfied that all was as it should be, he lowered his head and began to guzzle his evening drink.

The resulting sounds were scarcely indicative of proper table manners. He slurped and gulped with all the gusto of a truck driver over a cup of steaming coffee, and when at last he had slaked his thirst, he did the truck driver one better. He wallowed in his cup!

Gingerly, he waded into the water and lowered himself into the mud, and when half-submerged, he began to thrash with gay abandon. Legs, head, and tail were tossed in every direction as he rolled from side to side on his back.

Then after a moment he stopped, sat up on his haunches, and looked about himself in a most apologetic manner. He rose to his feet and, as daintily as before, tiptoed from the wallow to begin his nocturnal foraging.

It was now quite dark. Only the light from the moon overhead lent a shadowy detail to the landscape. The rhino, a vague black form, lumbered about the clearing, pausing now and then to nibble at the leaves of some low-growing shrub. In the darkness he resembled an animated boulder, and as such he was not particularly exciting. The time had come to take matters into my own hands.

With a flip of the thumb, I switched on a powerful flashlight, and the rhino stood motionless in a pool of light. Had I been on ground level, this action would have been nothing less than foolhardy, but here in the lofty security of Treetops Inn* I had ample reason to feel safe. Treetops, a glorified blind constructed in the branches of a giant jungle fig tree, is an ideal place for even the most timorous of sightseers to view Africa's most cantankerous game without an iota of danger.

After a moment of immobility, the rhino was galvanized into action. He squealed at the top of his lungs and, wheeling frantically, tried to escape this terrifying blaze of unknown origin. All at once he charged, first one way, then another, pausing between charges to squint at the light with his weak little piglike eyes.

Finally, when he could stand it no longer, he barreled out of the clearing as fast as his stubby legs could carry him. With no attempt to find one of the several trails that converged upon the clearing, he merely made his own as he galloped along, pushing down anything and everything that stood in his path. Long after he had disappeared from view, I could hear his panic-stricken squeals and snortings and the violent crashing of brush.

Incredible though it seemed, this mighty beast was scared stiff—the same animal that has been known to derail locomotives and overturn trucks. With my own eyes, I had only a short time before seen a rhino rout a herd of the dread African buffaloes. It was hard to believe and even harder to understand.

The answer came a day or so later from a veteran trapper, Hugh Stanton.

"The rhino's really a very mild-tempered fellow," he told me, and when I appeared skeptical he went on to explain, "He possesses notoriously bad sight. Consequently, the old boy's got to be constantly on the alert, depending almost entirely on his senses of smell and hearing. Any unfamiliar sound or scent sends him into uncontrolled panic. Frequently when he appears to be charging, he actually thinks he's running away from the danger."

"This," I remarked, "must be very comforting to anyone who happens to be in his path."

Stanton ignored my sarcasm. "Of all the animals I've collected for zoos," he continued, "I'd call the rhino by far the most responsive. I've found it possible to tame a full-grown rhino within a month of his capture. It's all a matter of mutual understanding. Treat him gently and quietly and you'll have a perfectly reliable pet."

All of Mr. Stanton's opinions may well be true (and I for one would hesitate to contradict them), but a rhino remains a formidable adversary in the bush. Rhinos are most active during the hours from dusk to dawn, at which time they are difficult to discern and thus avoid, being as dark as the night itself. During the day, they usually retire to the depths of the forest or, if they are plains-dwellers, into the densest thornbush thickets. Once they have entered the vegetation they become almost invisible. The nondescript gray of their leathery hides serves as excellent camouflage. Thus, an innocent traveler can stumble upon a rhino before detecting its presence, and in the resulting encounter it is sometimes difficult to convince the beast that one's intentions are harmless.

The black rhino is found in a variety of habitats: the lowland deserts, the upland bush and plains country, and even in the forested mountain ranges; but he is commonly looked upon as a denizen of the first two only. This may be due in part to the fact that game photographers, because of the nature of the forest habitat, have been forced to limit their activities to the other two, where the light and climate are better. But even fairly authoritative natural history texts sometimes dogmatically restrict the distribution of the black rhinoceros to the drier, open terrain of Africa south of the Sahara. Regardless of the cause, the black rhino, as far as the layman is concerned, has erroneously emerged as a creature of bush and desert only. Nonetheless, it is in reality every bit as much at home in the densest of East African mountain forests, and in some such areas it is extremely abundant. Hunters maintain that the mountain-dwelling rhinos develop longer horns than their lowland kindred, but otherwise they differ neither in appearance nor habit.

Wherever it occurs, the black rhinoceros is primarily a browser. It feeds on succulent aloes and euphorbias, as well as on the leaves of acacias and other scrubby trees. It is innately fond of wallowing, perhaps because of the hordes of insect parasites that dote upon it. Even the omnipresent tickbirds seem utterly incapable of coping with the situation. Although the rhino is a great wanderer, it is seldom found far from water; and according to native lore it possesses a remarkable memory for local geography, which guides it unerringly from one watering and wallowing place to the next.

Sociologically speaking, the black rhino is essentially a lone wolf. Only during the breeding season does one rhino customarily join forces with another. In but a single instance was I privileged to observe more than a solitary bull or a mother and calf at one time. In this case, a father rhino apparently wished to have a hand in the rearing of his offspring.

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* See "Treetops," by Lt. Col. and Mrs. William J. Morden, NATURAL HISTORY for May, 1949.

The scene was in Kenya's northern desert, near Wamba, and I watched it from the vehicle of Hugh and Jane Stanton, who were conducting me on a brief tour of the Northern Frontier District.

They made a tender sight, this rhino family. Mother, father, and half-grown baby stood testing the air suspiciously about three hundred yards away.

Stanton howled gleefully, "Now for some real sport!"

Somehow, I didn't quite like the sound of that. I had a very uncomfortable feeling that Stanton's idea of "real sport" might differ from mine.

He started the car, turned it around, and headed toward the rhinos. They stood their ground for a minute, snorted audibly, then scattered as we drove into their midst. We stopped and they stopped, one on each side of us and the third in front. Once again we began to move, and when we started, they started, this time converging upon the car. It was the beginning of a wild game of tag among the "four" of us, and it was one in which I did not care to be "it."

The three leathery, armor-plated monsters presented a thoroughly unpleasant picture as they rolled toward us from their separate directions, and the thought of the picture our vehicle might offer if they reached us was even worse. Apparently Hugh considered the same possibility, for he slammed his foot on the accelerator with a vengeance.

Off we went, with the rhinos on our tail, about a hundred feet behind us. Finally, they appeared to be thoroughly tired and stopped short in their tracks. Wheeling the car around, Stanton drove toward them again. At about eighty yards, he turned the car sharply to the right and, slamming on the brakes, switched the motor off.

"There's a picture for you!" he shouted.

I had completely forgotten about the camera in my hand and, at the moment, taking a picture was the last thing in the world I wanted to do. The rhinos, snorting and pawing the ground, were obviously on the verge of a charge.

"Let's get out of here. The heck with photography!" I yelled back.

Stanton shook his head firmly. "Not until you've taken your pictures."

I swore at Stanton, I swore at the rhinos, and I swore at the camera, but apparently I had no choice in the matter. I pointed the camera at the rhinos and without the slightest hope of getting a decent exposure (and caring not in the least) I began snapping pictures. Then all at once, the rhinos charged!

Mr. C. B. Perkins, one of my coworkers at the San Diego Zoo, has often sarcastically observed that I create the impression of existing in a perpetual state of imminent danger, regardless of where I am or what I am doing—and perhaps he is not without some justification. I wish, however, that on this occasion he might have shared in the adventure (and I vaguely remember wishing it at the time). Even now I do not like to imagine what might have happened had our engine failed or had we dropped into one of the all too numerous pig holes.

The rhinos throttled toward us like a trio of jet-propelled steamrollers, and I held my breath while Stanton ground on the starter. After a hysterical sputter, the car jerked into motion and away we went at a speed of nearly thirty miles an hour. The rhinos followed close behind, with their wicked horns aimed at

▼ The menacing horns of the black rhino are more dependable than its eyes. Notoriously bad sight keeps the animal on the alert, and any unfamiliar sound or scent will send it into uncontrolled panic

▲ **Wallowing** in the mud is great sport for the rhino—and possibly great necessity. The hordes of insect parasites that dote on the beast seem unable to cope with this activity

our rear bumper. We veered to the right to miss a boulder and swerved to the left to avoid a thicket, all the while heading for the road. The rhinos meanwhile had begun to slow down and, just as we reached the road, they lost interest in the chase and dove into a thicket.

As we resumed a normal speed, the color (or lack of it) on Stanton's face gave me a certain degree of comfort. Mrs. Stanton, who had remained tensely silent throughout the entire episode, now patted her brow delicately with a handkerchief and said, "Wheeeu! There was a moment there when I thought about pig holes." A moment! I concluded that any remarks I might make would be better left unsaid.

There is no more dutiful a parent than a mother rhino. She sometimes keeps her baby with her for several years—long after it is quite capable of fending for itself. Only a very young rhino is in danger of being preyed upon by other beasts and then only by lions. But the mother rhino looks upon her child as a precious but completely helpless infant, even when it is almost as large as she. Any cause for alarm, and she moves in front of the baby, daring the intruder to come one step nearer her beloved charge.

Other than man, the black rhino has few enemies. However, one notable exception, or so legend has it, is the elephant. Professional big game hunters insist that the two are deadly foes and that the elephant invariably emerges victorious from any conflict between them. A rhino, it is said, will never remain in the presence of an elephant. This seems open to question since on several occasions I have watched specimens of both species drinking from the same small water hole without the slightest indication of incompatibility.

The reactions of a rhino to other forms of animal life is entirely unpredictable. Sometimes it may drink or forage amidst a group consisting of several different species of animals and yet appear oblivious to their proximity. On other occasions it obviously wants the area all to itself and makes no bones about the matter. Whether this contradiction in attitudes is due to individual variation in disposition or merely the momentary state of the mind of the beast, I do not know.

One evening I watched a rhino charge directly toward a herd of buffalo, scattering them in all directions; and in another instance, a female rhino and calf sent a group of ten giant forest hogs scrambling away from a water hole. The rhinos were not content to drink until the forest hogs had entirely abandoned the clearing in which the muddy pool was located.

Numerically, the African black rhinoceros occupies a regrettably precarious position, and it has disappeared altogether from regions in which it was once common. That its numbers have dwindled so rapidly is due in part to the ravages of trophy hunters, in part to the inevitable encroachments of civilization, as well as to systematic slaughter of game of all types in the current and perhaps misdirected campaign to control sleeping sickness.

It is not inconceivable that the day will arrive when the black rhino has been entirely eradicated in the more open and accessible parts of its range, surviving only in the tangled mountain forests, which now constitute but a small part of its native haunts. Barring the removal of the jungles themselves, the black rhino may survive there almost indefinitely—a relic of the distant past, an awesome and incredible monster of the mist forests.

▼ **The black rhino** is essentially a lone wolf, and only during the breeding season is it customary for one rhino to join forces with another

Photographs by Hugh R. Stanton

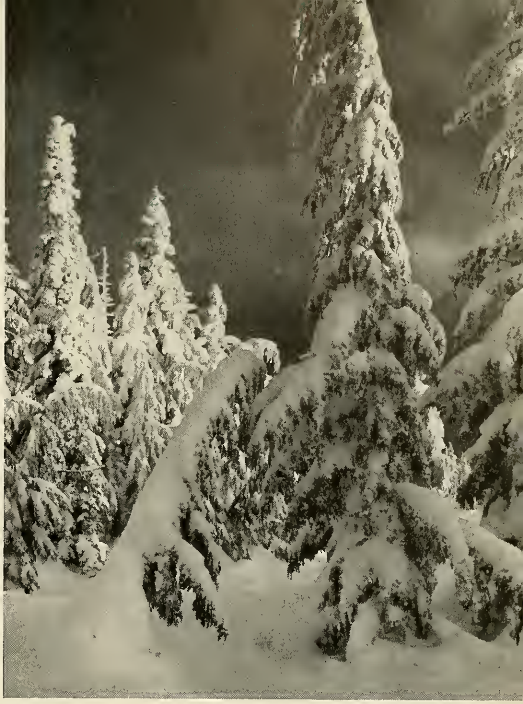
▲ TIMBERLINE LODGE below Mt. Hood peers above the snow only with difficulty. In February, with 200 inches of snow, Mt. Hood is a wonderland for skiers, and their sport continues into July

◀ ONE MARVELS at the patience required to carve such an intricate figure if it can last only as long as winter reigns. But the credit really goes to the sculptor who fashioned the monument underneath, not to the man who sprayed it with water to bring the covered wagon into harmony with the season at Sun Valley

WINTER *through the Camera's Eye*

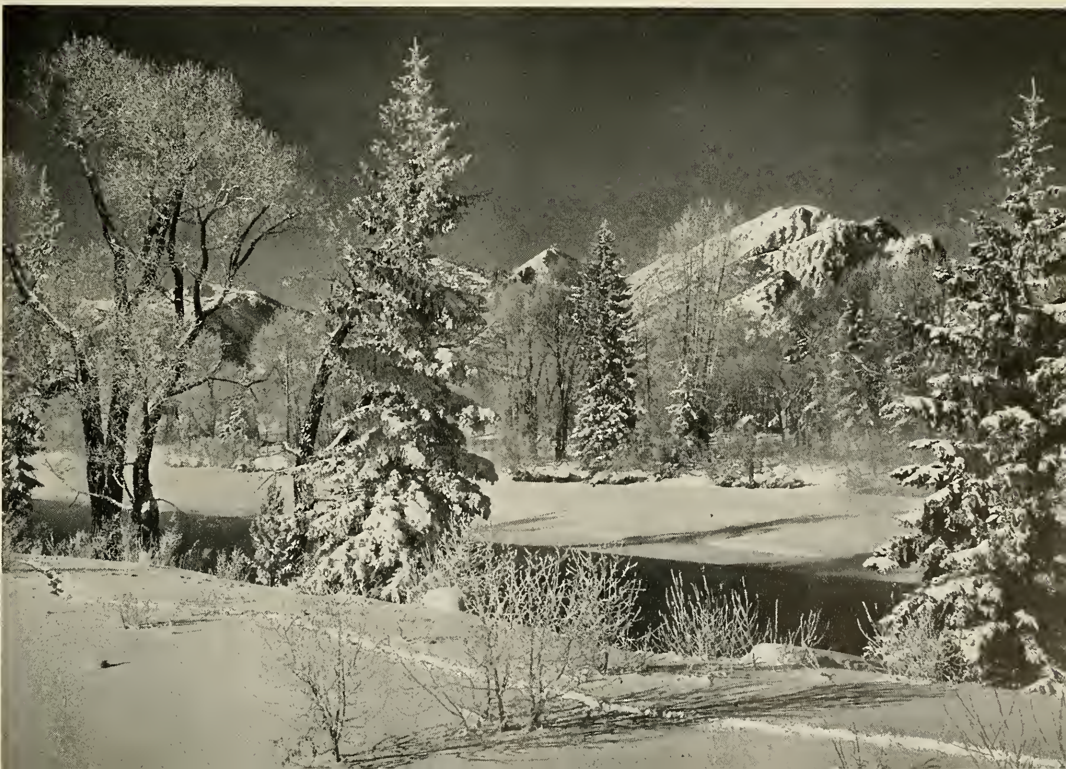
What artist dares to rival
Winter's creative genius?

By JOSEF MUENCH



▼ A FAIRYLAND greets the Snake River as it makes its pilgrimage through Jackson Hole in Wyoming. Every tree is ornamented with ice and snow, against the tranquil background of the crystal peaks

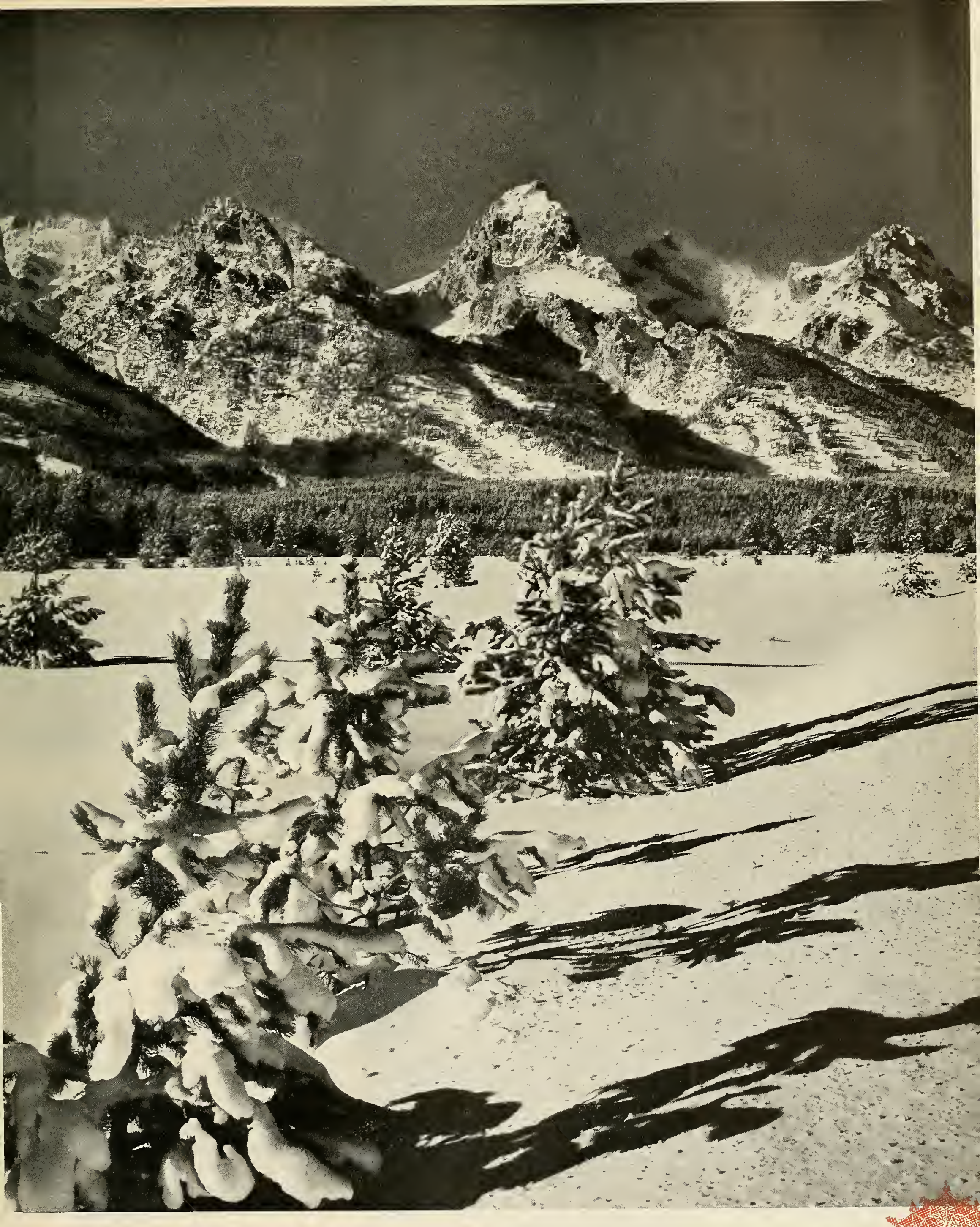
▲ EVERY TREE, with its burden of snow, becomes a fantastic creature, and the imagination peoples the forest with all manner of weird beings. South slope of Mt. Hood, Oregon



▲ A SKIER'S VIEW of Jackson, Wyoming, with the Grand Tetons rising in splendid array against the sky line

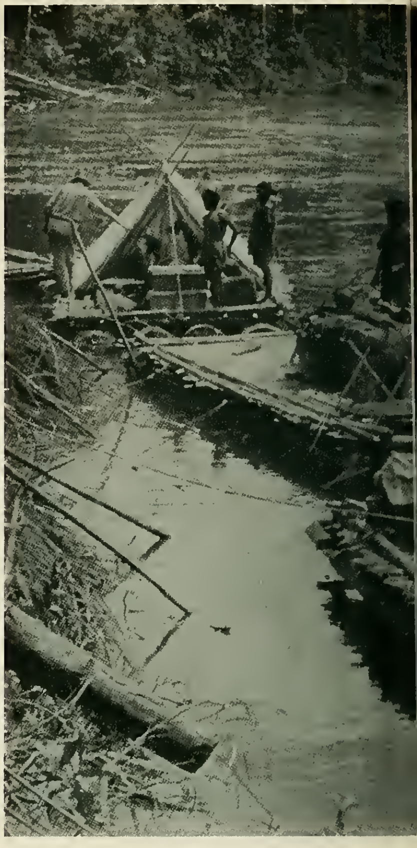
▼ YOUNG NAVAJOS, regardless of weather, ride their ponies over the lunar landscape of Monument Valley to herd the few horses they own

▼ ELK, coming down to a feeding station in Lamar Valley in Yellowstone Park. Like all of our National Parks, this is an animal preserve



▲ THE GRAND TETONS, lifting their snow-laden forms above the smooth valley of Jackson Hole. Grand Teton (*center*) is 13,766 feet above sea level, and its neighbors lift high enough to share its glory

▲ The "Kono" moored in a cove near camp. Before the accident, she brought all supplies from Port Moresby and Daru and dropped stores for nearly four-score men in the expedition's camps in the mountains. Her capsizing at Port Moresby occasioned the rafting adventure



➤ Three rafts nearly finished for the journey to civilization. Rand, in the foreground, directs the stowing of his collection of birds. The built-in fireplace is in the immediate foreground. The author's raft is already equipped with its tent. In the middle is one of the "boys'" rafts

Rafting

The story of a party of white men and their native Papuan helpers who journeyed on rafts hundreds of miles down a swift and almost unknown river in New Guinea

By G. H. H. Tate

Curator, Department of Mammals
American Museum of Natural History

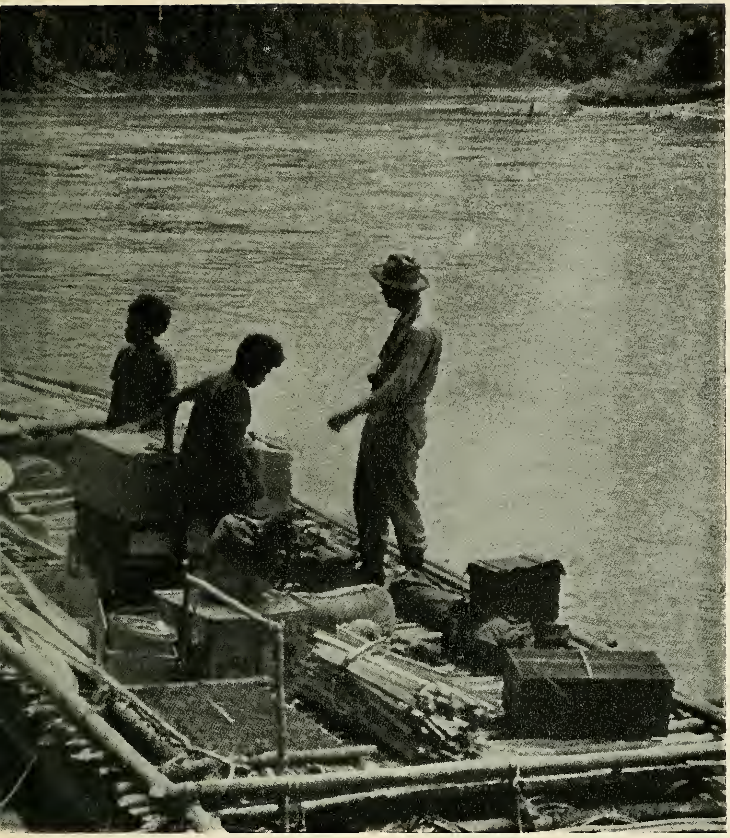
All photographs by Archbold Expeditions

The 1936-1937 Archbold biological expedition of the American Museum of Natural History had been in New Guinea but a few months, and 5 of its members with 75 Papuan natives were in the final stages of an attempt to reach the very heart of the great central highlands at the head of the Fly River—when the accident happened. The amphibian plane that had carried us into the interior hundreds of miles from our base at Daru, and afterward acted as aerial ferry and supply ship, capsized at her moorings in Port Moresby harbor. Word of the disaster reached us by radio, together with assurances that a rescue launch would be sent upriver as soon as obtainable.

Our upriver party comprised the ornithologist A. L. Rand, in charge; L. J. Brass, botanist; Michael Healy, police officer; Alan Willis, in charge of native labor; and the writer, who besides collecting mammals and invertebrates operated the radio set. A few weeks earlier we had divided into an advance party cutting track up the forested, rain-soaked mountains and a collecting party stationed at the foot of the mountains. At the time of the crisis Willis, Healy, and I, with most of the "boys," were in the advance group almost a week's walk beyond the camp where Brass and Rand with their helpers were at work.

The prospect was alarming chiefly because our mountain party had food for only nine days, and the weather was so stormy we could not be sure whether extra supplies could be flown in to us. Flying in those poorly mapped mountains in such weather was extremely dangerous. However, a chartered plane flew over a few days later and through an opening in the clouds spotted one of our camps and dropped additional food. Meanwhile the group at the foot of the mountains had picked up the bad news. It was then reluctantly decided that as there was no longer any way to supply the advance group the upland work must be abandoned. We had but one way to leave: the mountain group must walk back to the lowlands camp, and rafts must be built there so that the entire party could float down the river.

I took a gang of boys and the radio set and moved out first, followed a few days later by Willis and Healy with the rest of the hired natives. It was a nightmare trek amid almost



own the Fly River

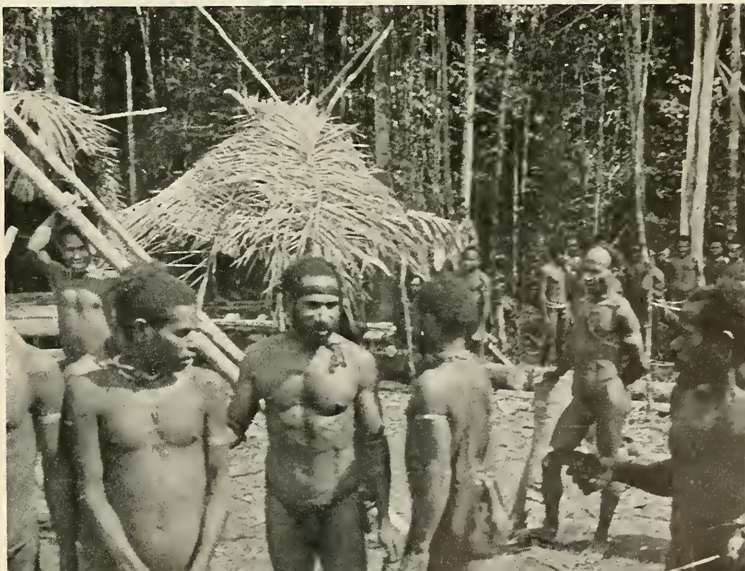
constant rain over the most rugged, densely forested terrain imaginable. Suffice to say that we got there and found Rand and Brass with every available man already felling trees with which to build rafts.

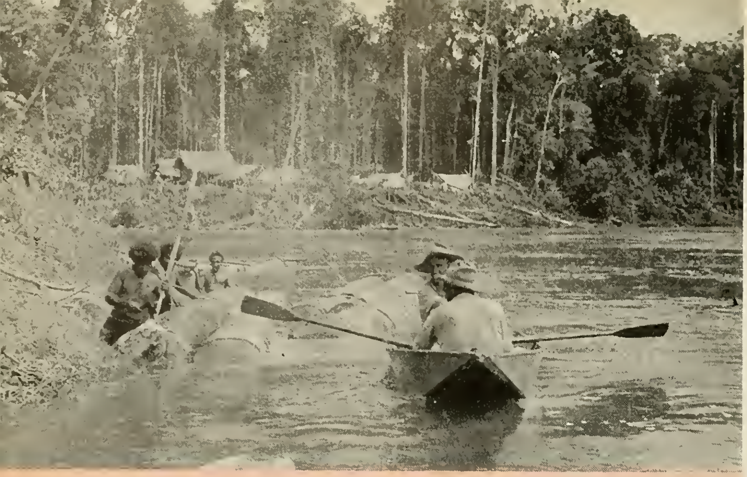
The main camp in the lowlands stood in a tiny clearing amid tall forest, at the edge of the Palmer River, a principal tributary of the big Fly River. The Palmer was a stream 70 yards across, unpredictable and full of vagaries, rising and falling a score of feet with the changes of the weather in the mountainous hinterland. The wild native bushmen had come to tolerate our presence to the extent that the lives of our "boys" were reasonably safe provided they went about in pairs, one of them carrying a gun. But to ensure perfect safety at that time of the emergency, the boys were sent into the forest to cut great logs for raft building in groups of half a dozen, with an armed policeman in charge. Meanwhile our precious collections of zoological and herbarium specimens, comprising hundreds of preserved birds, animals, insects, and plants, were packed, and a beginning was made of dismantling the camp.

For days the forest echoed to the sounds of chopping and the periodic crash of falling trees. At intervals a boy came riding downstream astride one of the huge logs, guiding it with astonishing skill by means of a paddle improvised out of a stick. Each tree trunk arrived equipped with a "bush rope"—fashioned out of the climbing palm known as *Calamus,* the rattan of commerce—tied tightly to it to act as a mooring rope.

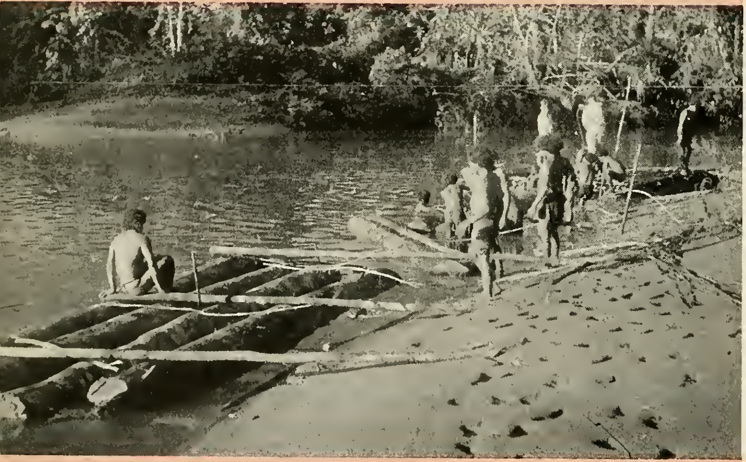
The logs were assembled at the mouth of a small stagnant creek near camp, which had been selected as

▼ **The "A-win" tribe** of the Palmer River, coming to trade natural history specimens for beads and pigments with which to adorn themselves. It was one of these natives who stood in the deserted camp beating on a kerosene can when the raft flotilla drifted past. The palm covering over the tent is a sunshade

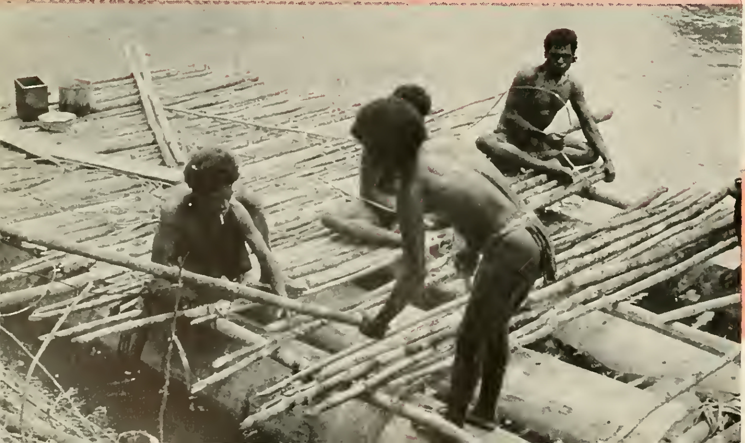




▲ **An early stage in raft making.** The boys rode the logs down the river and assembled them in spots sheltered from the current. Healy facing the camera, Rand at the oars in the folding dinghy



▲ **Lashing the float logs** together with heavy crossbars. The bush rope used was a climbing palm, *Calamus*, locally called *wairo* and known to Australians as "lawyer cane"



◀ **After** the main lashings and crossbars wer completed, a second series of poles laid length wise formed the foundation of the deck o poles or split palm stems. The deck stood a most about one foot above the water leve

the spot best suited for construction of the rafts. Several boys were detailed to collect quantities of "wairo" (*Calamus*), with which to lash the yard-thick logs together. Building operations started. The tree trunks were lined up parallel in groups of four and were held there by means of poles thrust deep into the river mud, while band after band of tough-fibered bush rope was looped around them and pulled up taut. Strong cross poles were bound solidly into place above the float logs, and on top of them again was tied a floor made of split sago palm trunks, the whole built up to give the deck surface a clearance of about one foot above the water. Not a nail or any other piece of metal went into the construction. The biggest raft was estimated to weigh close to six tons. When completed, it measured 11 feet wide and some 25 feet long. The smaller rafts attained only about three quarters of the dimensions of the largest; their cargo-carrying capacity was, of course, very much less.

Each night a police guard was stationed to watch the precious shipyard lest some mischievous bushman cut our hard-won navy adrift.

In something more than a week, the work was done. Twelve sturdy craft, moored fore and aft, lined the water's edge. At the rear of each was a quantity of firewood and a built-in fireplace for cooking made of a large shallow box filled with sand. Each raft was also equipped with a steering oar and half a dozen paddles. The order was given to embark.

When an unknown river must be traversed for an undetermined number of days, it is well to take every precaution and lay plans with the utmost care. Our party hoped to be able to keep together so that if any raft got into difficulties, others might come to its assistance. Each day we would start out as soon as possible after daybreak and travel until an hour before dark. A small collapsible dinghy served to keep up communications.

Five of the craft were captained by white men, the other seven by the native police sergeant, the cook, and selected boys. The crews were carefully chosen and assigned. Supplies of food and equipment were stored near the center of each raft and covered with tarpaulin so that the heavy splash of water from rapids or whirlpools would be less likely to reach them.

Each white man arranged his raft and equipment to suit his tastes. Each also assumed responsibility for his own collections. As I had charge of the radio set and power supply, with a small stock of gasoline for the motor, I was assigned the biggest raft. Each man had a sleeping tent small enough to be erected on the forward deck. This, with a strip of canvas shading the deck just in front of the tent, made a combined sleeping place and piazza from which, seated in his folding canvas chair, the skipper could survey the whole river. The cook, the crew, and the man at the steering oar lived at the rear. So much for our preparations.

During the last few days, the forest people, the "A-win," had been gathering. They divined what was about to happen, and they began to assemble so as to be first into the deserted camp to gather abandoned treasures such as empty cans, sacks, boxes, and gasoline tins.

One by one the rafts pushed off into the deep, swirling current, for the Palmer River was once more rising as a new flood descended from the cloud-hung mountains. The crew of each raft paddled hard for midstream so as to avoid being carried into the low entangling branches that overhung the banks.

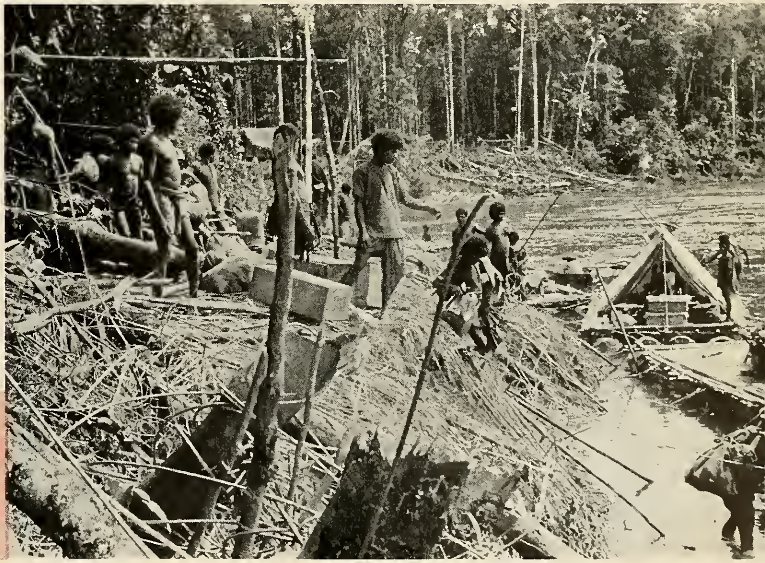
As we swept past the camp we had occupied for months, we saw a bushman standing there, his filthy hair plaited with straw, his nearly naked body daubed with yellow paint—obtained from us in trade for animal skins. He shouted unintelligibly and beat violently with a club upon an old kerosene tin. A few seconds later a bend of the river cut him off from our view. Bad weather had been threatening. It began to rain.

Every man concentrated tensely upon the behavior of his raft and its navigation. The helmsman found that he could hold the head of the craft downstream with comparative ease. But we found it very difficult to move nearer or farther from the bank. A decision had to be taken, as we approached each turn in the river, whether to guide the raft to left or right. So ponderous a mass of logs surging along on a seven-mile-an-hour current required hard paddling on the straight stretches in order to have it in position for the next curve. In places, rocky headlands pushed out into the stream, setting up back-eddies whose effects upon the rafts varied from mere annoyances to really dangerous whirls.

Sometimes the river widened enormously. At such places huge, slow-moving eddies existed, whirls a hundred yards across and perhaps three times as far up and downstream. They helped us work in from midstream to the bank when it was time to tie up for the night. But they also held us tenaciously when we wished to leave in the morning. My large raft was so unwieldy, its inertia so tremendous, that despite violent efforts, the paddlers managed to drive it out of one of these eddies only after two tries—and each complete circuit of the backwater required just twenty minutes to complete.

When a rapidly flowing river rounds a curve, the current moves slowest close to the inside, fastest at the extreme outside. The approach must be made about halfway between the inside bank and midstream. If a raft came too near the inner bank, it was likely to be drawn into an eddy. But it was far worse to approach on the outside. The velocity of both water and raft increased alarmingly, and the vast momentum generated by the tremendous weight of the timbers tended to drive the craft tangentially outward, perhaps to strike against rocks and break apart.

Such an experience almost befell one of the convoy. The crews of the rest watched in utter helplessness as, wholly beyond control, one raft



As the rafts were completed, the "ship-
rd" became a veritable tangle of discarded
ish rope. On several of the rafts small tents
ere erected. One raft, finished before the
hers, is partly loaded with supplies

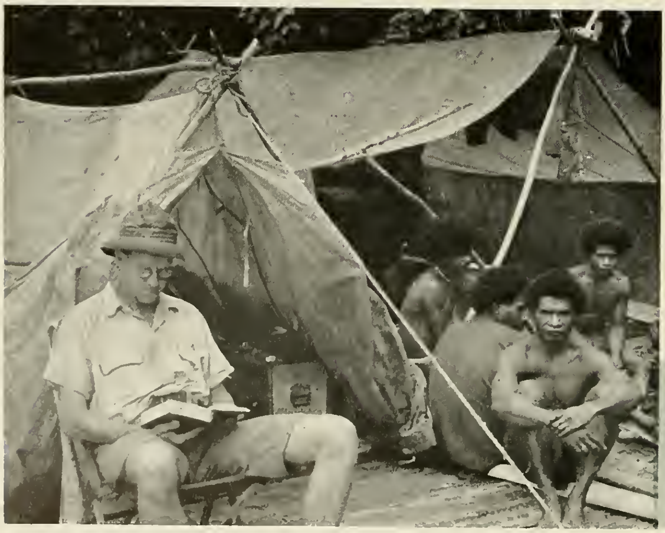
load of natives drove down the outside of the bend. The water seemed distinctly to pile up against the projecting cliff face. A huge, half-dead tree leaned low over the river, the tangled branches of its crown directly in the path of the ongoing raft. The next instant they struck it. Two of the men jumped overboard. The raft tilted sickeningly, and a great snag of wood plowed a six-foot gash through the tarpaulin. Then it swung clear. Fortunately, the river straightened out from that point, and the two swimmers climbed on board again. A few hundred feet below, when they tied up to the bank in a patch of slack water to check up the damage, they found that by something approaching a miracle nothing but the torn cover had suffered injury.

Another raft met with a minor accident by getting into water too shallow for its draft. The river had shallowed rather abruptly, and the swift current thrust the rectangle of logs relentlessly upon a bank of grating gravel, much to the detriment of the lashings that passed under the logs. Quite half the bush ropes were cut through, and most of the others badly frayed. The risk that the raft might go to pieces appeared so great that we decided to put into a quiet cove at once, cut new lashings, and make repairs. The lead raft was tied up at a suitable place on the inside of a wide sweeping bend where the current ran less violently. The crew grappled with overhanging vines. Chopping violently with their cutlasses, they carved an entry and withdrew their tent-covered craft almost from view. Raft after raft followed the lead of the first one, each coming to rest a few yards downstream from the one that had preceded it, until all twelve were snugly moored in a compact row, reasonably safe from disturbances by floating driftwood.

Half a dozen boys, under the police sergeant with his rifle, were dispatched to cut a supply of bush rope for reinforcing the lashings of the raft that had scraped the shingle bar and for stiffening the construction of any others requiring it. Meanwhile, gangways were quickly extended from the rafts to the low bank as well as from one raft to the next. Cooks carried their pots and supplies ashore, glad to move freely after many hours of cramped quarters on board. As darkness grew in the forest, campfires gleamed here and there, picking out the great boles of near-by trees, the sheen of the boys' limbs, their great golliwog-like mops of hair, and the red of their ramis—the apronlike garments they wore instead of trousers. Such evenings are pleasant to look back on. While waiting for supper to be made ready, we five whites gathered together, cup in hand, taking the evening rum and water to wash down the quotidian quinine capsule. Events of the day were discussed. Cigarettes and a pipe glowed in competition with the erratic flashes emitted by cruising fireflies. A dull red glow in the sky, reproduced in the mirror-like river, alone served to recall the sunset. After supper, "notes" were written, and every man climbed under his mosquito net.

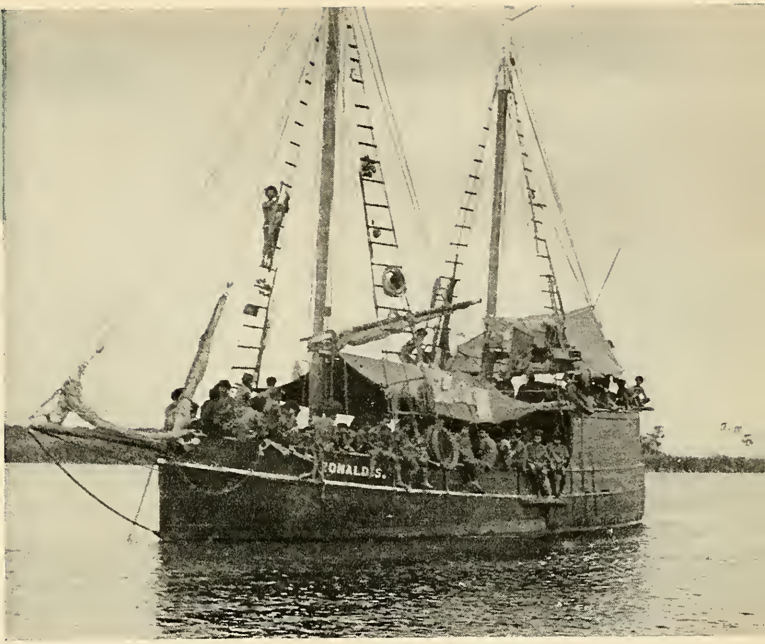
One day the party had started under perfect conditions, the weather fair, no cloud upon the horizon. But soon things changed. Rain had been falling heavily in the mountains, and presently its effects reached our raft convoy. For the rest of the day water fell in torrents, the surface of the river jumping and boiling under the ceaseless pelting of the downpour. Visibility was often less than 100 yards. Perhaps that accounted for the very poor place at which the rafts were tied up for the night; for when the rain slackened a trifle just at sunset and we could see where we were, we found ourselves lined along the outside instead of the inside of a bend and, as later investigation brought out, tied not to the true riverbank but to a low island, whose surface then stood only a few feet above our decks. As darkness fell the river began to rise again. A big flood was coming.

That night was an anxious one. The water rose steadily; the current grew stronger. Many additional *Calamus* mooring lines were set out from each raft. My own heavy craft hung swaying and trembling at the ends of no less than eleven such lines. And on every raft, boys were stationed with flashlights and long bamboo poles, ready to fend off the



◄ RELAXATION after the worst of the rapids had been passed: two rafts tied up securely on one of those few nights when the rains held off

➤ **The rescue ship.** The "Ronald S." may not be "a thing of beauty," but she appeared a wondrous vessel to the explorers when she chugged up the river to their last raft stop. She was a little crowded at times



drifting logs which the torrent thrust perilously close. The water continued to creep up inch by inch, while the raft crews chopped a way in among the sapling vegetation, in order to save us as much as they could from the direct pull of the current.

Presently the island was covered. An hour later the rafts, which drew from two to three feet, floated in over the top of the bank and were additionally secured by heavy stakes driven down all around them into the mud. Still the water level rose.

It must have been nearly midnight when a hail from the first raft warned us all of trouble. Only a few yards away a huge tree, torn from the bank far up the river, was driving past, roots foremost, as majestically as a ship. Just as it drew abreast its roots locked with some obstruction under water, and it hung, teetering for an instant while the river tore and raged through its branches. Just in time our boys, thrusting in unison with poles, stopped the inward swing which, had it completed itself, might have torn several rafts to pieces. The head of the tree was deflected outward toward mid-river. An instant later that danger had vanished in the darkness.

But the greatest trial of all came just after dawn. The men were resting, worn out by the night's vigil, the cooks were making shift to brew some coffee, and it seemed that the peak of the flood had passed.

Some of the crew of the last raft in line glimpsed what was coming and yelled to those up ahead to "look out." But it was too late. A tremendous, relentless crashing of saplings announced the approach of two gigantic interlocked trees that pivoted against each other with a kind of scissors movement. Crashing through the low screen of the island vegetation, they struck the leading raft and drove it with a terrible blow against the one behind it, and that in turn against the third. So violent was the shock that almost every mooring line in the row of rafts was snapped and the component logs of all the lead rafts were driven askew. A twist of the current drew the hinged tree trunks back to deep water, carrying our first raft pinched between them.

The crew of the front raft had barely had time to see what was swooping down upon them. All except two boys and Willis, who was captain, jumped over into the water. Those three were carried away down the river between the locked tree trunks. Their tent was torn down; they had no paddles and only a couple of poles to maneuver with. They quickly passed around a bend of the river out of sight. Two boys were at once sent after them in the dinghy with food, water, ropes, and paddles.

That incident marked the end of the struggle. The water began to recede. Every half hour its depth was probed. The current was still very strong, but we had to ease out into it a little so as to avoid having our heavy rafts come to rest on the top of the island, like Noah's Ark upon Mt. Ararat. It was almost sunset, however, before the island actually emerged. Sleep was never so welcome as that night.

In the morning the journey was resumed. Half an hour downstream the dinghy came alongside, the boy at the oars bringing a note from Willis saying that all was well. The raft had been freed from the big logs very quickly; they had repaired the lashing and repitched their tent; they were only a little way ahead.

Presently the already large Fly River converged with a tributary, also of great width. The current slowed to two miles per hour. A strong sea breeze rose in the afternoons, driving short, choppy waves up the long, straight reaches and sometimes dashing spray all over us. There was now depth of water enough for the rescuing schooner to travel without great risk of running aground. We tied up our convoy for good at an abandoned prospecting camp, the farthest upstream, to await the river boat.

Months later, as I stood on the bank far down the river, I saw one of our rafts again. It had broken adrift and was heading for the sea.

Curiosity Caught a Booby

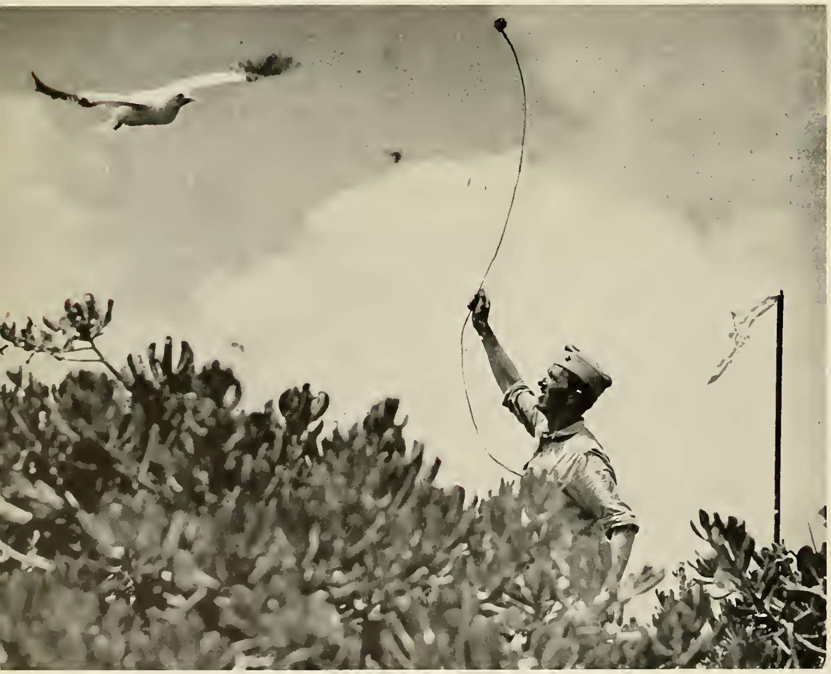
A method developed by early man has proved of value to starving men on life rafts

By Lewis Wayne Walker

Photographs by the author

DURING the Pacific war, the raft holding Eddie Rickenbacker and his two companions had floated for six days somewhere on the world's largest ocean. The men had had no food or water from the start. Their outlook for rescue seemed almost hopeless. And then on the seventh day, in a miraculous way, a bird circling the raft alighted on Rickenbacker's hat and furnished nourishment that kept them going for a few more days, enabling survival until search planes finally ended their floating ordeal.

Many other pilots can thank such chance captures for their survival, and yet the few pelagic birds that voluntarily landed on shoulder or outstretched hand were only the most unwary of the ocean flyers—probably young of the year, whose



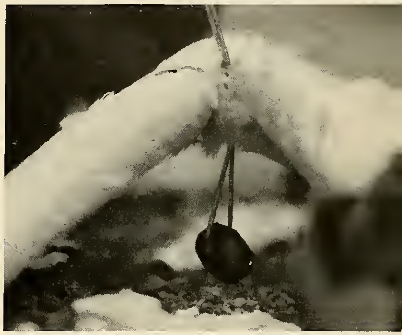
▲ A Red-footed Booby approaches the white rag

innate curiosity overcame their developing fear of man.

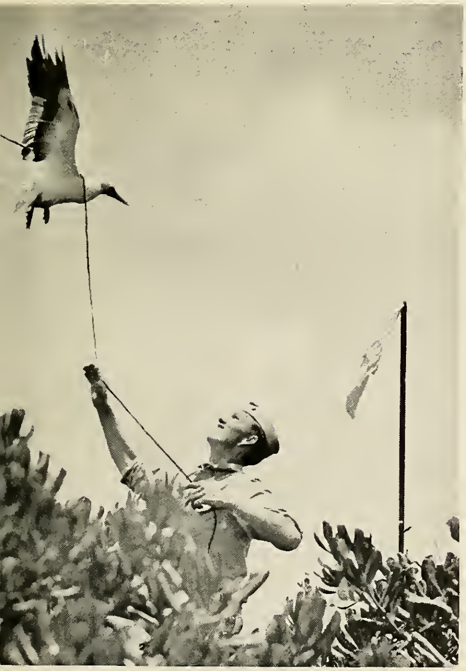
About 65 generations ago the Polynesian peoples migrated to the lonely, uncharted islands of the mid-Pacific in simple canoes with limited space for the storage of foods—vessels so frail that we might now hesitate to use them on our placid inland waterways. Their initial exploratory trips were based on wishful thinking—the hope that an island existed beyond the horizon. Weeks and months passed far from the sight of land, and the venturesome occupants were forced to subsist on the birds and fishes that they were capable of catching en route. However, in previous centuries of island hopping, first close to the Asiatic mainland and finally eastward to Hawaii, they had learned that many of the pelagic birds were extremely curious, drawn as though by a magnet to a fluttering rag in the breeze. This knowledge was passed orally from generation to generation and eliminated much of the element of chance in the capture of feathered foods on the high seas.

Throughout the centuries that elapsed since the inception of this simple Polynesian system of luring, some of the nesting islands have been invaded by man, and the birds have naturally lost some of their fearlessness. Generally speaking, the brazen, foolhardy birds have been eliminated and only the sagacious have survived to propagate their kind. This change was noticeably accelerated in the relatively few short years of the war. When the military forces first arrived at Midway, man-of-war birds, boobies, and terns would sit on their nests until pushed from their eggs. However, after two or three years of military occupation, this trusting nature was undermined, so that practically all of the nesters would temporarily desert when a human approached within a six-foot radius. But—and this was important to castaway pilots—the curiosity of the birds remained unimpaired.

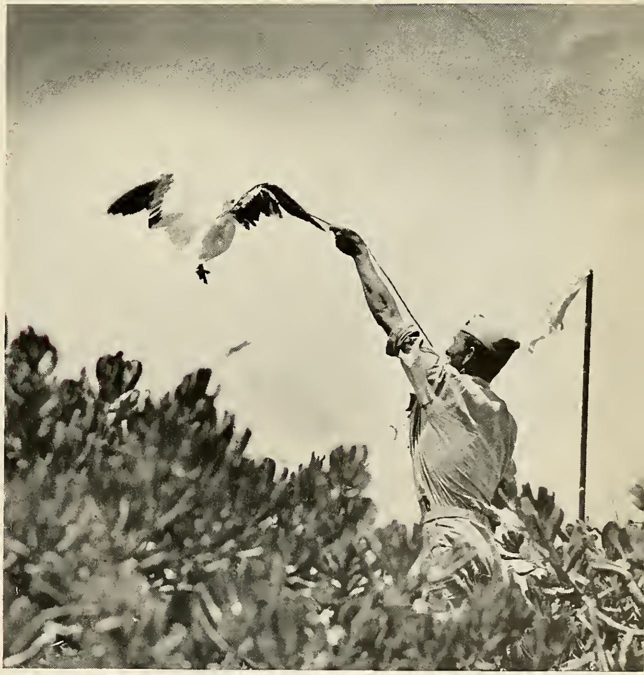
During my tour in the Marine Corps, I was assigned to the Survival Training camp, and it was my duty among other things to test the practical utility of the theories



▲ THE WING of the captured booby with the string in place



HE WEIGHTED STRING starts to wrap around its wing



▲ THE BIRD is pulled to the ground

being taught to the pilots. The ancient history of the Pacific was literally picked to pieces in the effort to find and test any forgotten arts that might hold better promise of life for castaway or life raft occupant. If found impractical they were discarded, but if feasible they were added to the curriculum of the survival school. Thus bird-catching became one of my jobs.

Moko Manu Island, a few miles off the coast of Oahu, was chosen for the initial tests. Incubating birds of several species dotted the ground, but they moved off and took flight whenever they were closely approached. They would have been difficult to procure without slingshot or club. Then we tried the legendary system of the ancient Polynesians and tied a white rag on the end of a branch. When we allowed it to flutter in the breeze, boobies stopped their aimless circling and zoomed toward the waving material. With beating wings they slowed and hovered momentarily on its lee side, seemingly so entranced by the motion that they were oblivious to the human a few feet below. I started a pendulum motion with a string weighted on one end, and when the bird above was in the right position I swung the weight in the air, up and over the hovering form. The instant the string touched the outspread wing, the weight caused it to wind around, making the bird my captive. Primitive peoples in various parts of the world have used these so-called bolas for catching birds or other creatures, and many will recall having heard of them among the Gauchos of Patagonia.

On those first tryouts we made eight catches in eleven attempts, and this average was almost upheld when later experiments were made from a floating life raft. All of the birds were liberated after being unwrapped, but several of them swung around in a great circle to the decoy again—sure evidence that the birds called boobies are not misnamed.

ESKIMOS Glaz

▲ THE SLED IS tipped on edge against a block of snow to expose the runner without unloading everything

heir Sled Runners

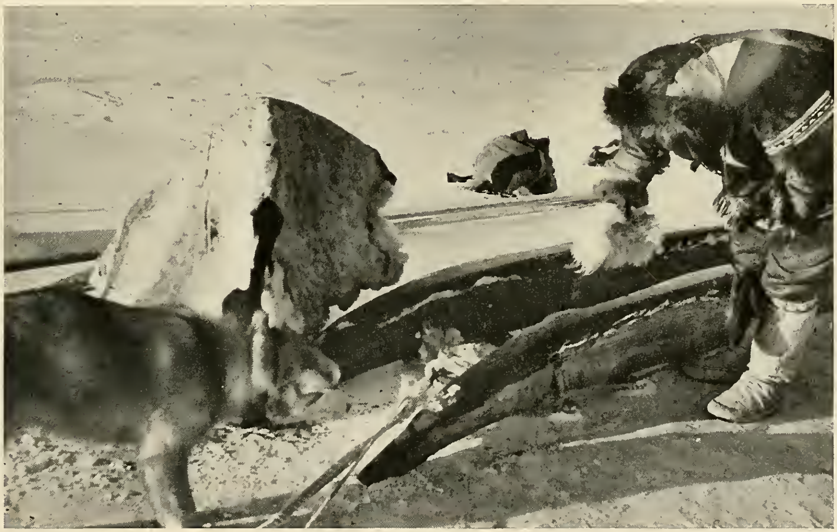
Lubricating oil would have little use in their wheelless life, but they have devised an ingenious method of overcoming friction

By The Rev. Canon J. H. Webster
St. Andrew's Mission, Coppermine, N.W.T.
Photographs by the author

ESPECIALLY when the temperature falls far below zero, the dog sled plows through the dry snow as though it were going through sand, and the effort of pulling it is doubled or tripled. The Eskimo then needs a coating of ice on his runners. Ice will not stick well to wooden or bone runners, so a backing of frozen mud must first be applied. This is made by mixing earth, moss, or other material with water and applying it as a paste. Sometimes today, rolled oats or other porridge is used. The frozen mud is then smoothed with a woodworker's file or an old plane, and a coating of water is applied. Sometimes the water is warmed in the mouth and squirted on; sometimes it is heated in a pot and poured onto the bearskin mit that is used to smooth it quickly before it freezes.

On rough ground the ice shoeing often breaks off, and repairs have to be made on the trail. The Eskimo carries a little bag of water just for this purpose. This whole procedure—an arduous one under sub-zero conditions—is not merely a fad among a few sled travelers. It is a familiar routine to most of the Eskimos from Alaska to Greenland.

▾ Care is used in shaping the backing of mud. Note the smooth surface that is formed before application of water



▴ While the ice was being applied with the fur "smoother," the runners were shaded from the April sun by a propped-up skin in this instance

➤ The one who benefits: a sled dog happy for the rest and grateful for a new pair of frictionless runners

MONTEZUMA'S

Pink Castle

The vast lands of the Southwest were theirs for the taking, but enemies forced hundreds of early Americans into a five-story apartment house—an architectural achievement but a prehistoric slum

By Nell Murbarger

WITHIN 150 miles of that famous corner common to four states may be found virtually every known cliff dwelling in America's Southwest. One notable exception is Montezuma's pink castle. Situated more than 200 miles from the above-mentioned point and almost directly in the center of Arizona, the Castle is far more widely known than most other cliff dwellings. It is easier to get to, and the public has long been conscious of it.

Passage of time has done nothing to diminish its appeal. During the travel year ending on September 30, 1948, more than 26,000 persons were stirred by the sight of this five-story apartment house, built half a millennium before Columbus set sail for the so-called New World.

No one seems to know who was responsible for giving this edifice its name. Certainly he was a romanticist. Not even a high-salaried Hollywood press agent could have devised a name with more public appeal. Montezuma's Castle! Montezuma, the picturesque and fabulously wealthy king of the Aztecs . . . and coupled with this, the word Castle—a holdover from fairy-tale days, a place of turrets and moats, of dark deeds and clanking swords and knights in shining armor. Surely the components of romance unfettered.

Climbing down into the levels of reality, however, we find that this building never was a "castle" in the sense of being occupied by one potentate and his court. Rather it was a prehistoric apartment house, tenanted by many families. As for Montezuma, there is no record that this Aztec leader ever set eyes on what is now Arizona. Most certainly he never dwelt in this cliffside aerie, because the place was built, occupied for a dozen generations or so, and abandoned to the winds all before Montezuma's birth in 1476.

Fortunately, the known story of Montezuma's Castle is no less romantic than the fanciful connotation of its name. In the first place, there is probably no more pleasant spot in all Arizona than the colorful Verde Valley in which it is located. Fed by numerous mountain tributaries, the tree-bordered Verde runs deep and clear and cold through a smiling meadowland. Here grass grows tall and green, and wild flowers bloom. Flanking the fertile valley are high, perpendicular cliffs of white limestone, brilliant red sandstone, and outpourings of dark lava. Stretching back from the rim of these cliffs are the high, wild plateaus of north-central Arizona; and still farther distant lie snowy blue ranges, densely forested with pines and fir and teeming with fish and wild game.

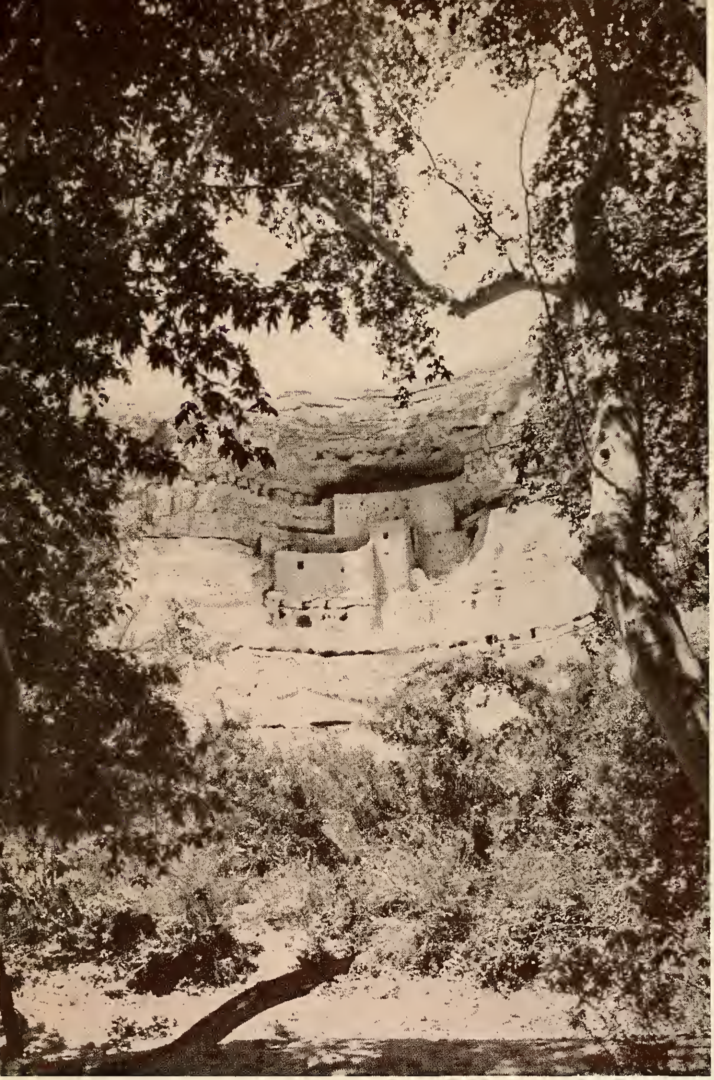
Southerners from the lands of the Salt River and the Gila moved into this attractive valley. As nearly as students of archaeology have been able to determine, this migration took place during the eighth century. While this was an age that saw nearly all the world's "civilized" men engaged in warfare of one sort or another, even then these Hohokam were a thrifty, industrious people—peaceful, well-fed agriculturists who knew the proper time to plant corn, squash, beans, and cotton, and how to lay the grade of irrigation canals so that the life-giving water of the river might be carried to the valley's farthest fields. Here they apparently knew freedom from persecution for 200-odd years.

In addition to their agricultural activities, these people made relatively good pottery vessels of two types—plain gray, and buff with red designs. They lived in one-room dwellings fashioned of poles overlaid with brush and reeds and plastered with mud, thus affording wind resistance and a measure of security from rain and snow. They were a distinctly rural people, having no cities or large centers of population. They lived a single family to a dwelling.

About the beginning of the eleventh century, trouble appeared on the scene in the form of nomadic hunting Indians—men most familiar with hunger and privation. Suddenly, the well-filled granaries and storehouses of the Verde—hitherto a source of both individual and tribal pride—became only centers for looting, and their defenders, candidates for death.

While methods of warfare, of offense and defense, have changed with succeeding generations, the principles have remained unaltered. Since the siege of Tyre, beleaguered men have sought strength in numbers. On the Verde this meant gradual abandonment of the single-family dwellings and ultimate construction of great communal tenements. By virtue of their location, on hilltops or in natural caves in the cliffsides, such pueblos were far more defensible than had been the individual homes.

It must have been with great elation that a group of the harassed farmers first realized the building



Nell Murbarger photo

▲ **Built** about 9 centuries ago, Montezuma's Castle was occupied as a fortress-home for possibly 300 years. Unsanitary living conditions may have contributed to its decline. The Aztec leader for whom it was named probably never knew of its existence.

possibilities offered by a great cavern-pitted limestone cliff that lay along the north bank of Beaver Creek. Here, beside this sparkling little stream, was farming land equal in every respect to that flanking the Verde, four miles distant. Here flourished wild berries, nuts, herbs, and medicinal plants. Here were wild animals for the hunting and trees ample for building purposes; and, most important of all, here was a sheer 150-foot-high cliff indented by great crescent-shaped pockets in which 100 men and their families might know safety and security. Thus was begun one of the Southwest's most magnificent building projects of prehistoric times.

Before that limestone haven on Beaver Creek could be made useful to man, it was necessary that a usable trail be forged up the cliffside. In some places this was done by gouging hand and toe holds in the solid rock. Other sections of the tortuous climb were spanned by ladders, consisting of crosspieces bound to poles by means of skin thongs.

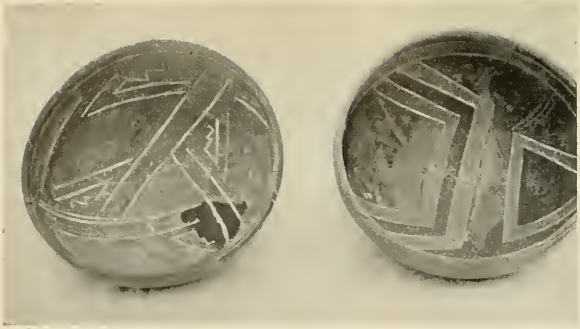
When tribal workmen set about felling the great white-barked sycamore trees for ceiling beams and floor joists, it was necessary that they accomplish that gigantic undertaking by means of crude stone axes. They lopped off the branches and cut each timber to proper length to fit some individual requirement. Then followed the tremendous task of transporting these cumbersome, unwieldy beams up that sheer rock wall to the chosen niche.

One by one the log timbers went up the cliffside, there to be fitted into notches laboriously hacked from the solid rock of the cliff's rear wall. Meanwhile, over the same trail, borne on human backs, were carried adobe plaster and mortar.

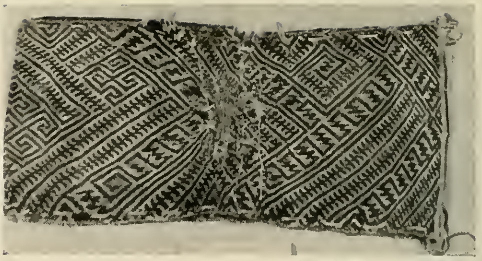
We know that when the project was completed, three distinct apartment houses had been erected within a half-mile section of cliff wall. Largest of these was a tenement six stories high, containing forty-five rooms. One hundred yards farther east rose a second communal dwelling of five stories and twenty rooms.

The six-story apartment was destroyed by fire and abandoned a hundred years or so later. The second in size—Montezuma's Castle—still stands, 90 per cent intact after 900 years. Its remarkable state of preservation is attributed to the great shelving overhang of rock which has served to protect it from the elements. It was lived in for 300 years. In the United States today, there are few buildings of white man's make that have been used for so long a period, even among the venerable Spanish missions of New Mexico.

During those three centuries the inhabitants of Montezuma's Castle lived through the Great Classic Period of pueblo culture. Although they never progressed into the use of metal, their stone tools and implements showed constant improvement of line and craftsmanship. Also, they made baskets of pleasing appearance and sturdy construction. They wove durable sandals and bags of yucca fiber. They made pottery



▲ **The people** of Montezuma's Castle made pottery in brown and red and gray types. These polychrome bowls were found in graves



National Park Service photos

▲ **An ancient cotton bag** from Montezuma's Castle, twelve inches long and woven by the "weft-floating" technique

in brown and red and gray types and traded with the Hopis and Indians of the Flagstaff area for white pottery artistically decorated in black. They made exquisite jewelry of turquoise mosaic and of seashells traded from the Pacific coast or Gulf of Mexico.

Perhaps the greatest of their accomplishments, however, was the highly-skilled manner in which they manufactured cotton cloth. We are often inclined to regard cotton as a relatively recent innovation, yet long before white man ever set foot within the province of Arizona and New Mexico—even as much as 1200 years ago—Indians of that region were cultivating extensive fields of short-staple cotton.

From their irrigated farms along Beaver Creek, the people of Montezuma's Castle and adjacent pueblos gathered their fluffy white harvest, ginned the bolls by primitive means, and spun the linters into yarn and sewing thread. This, in turn, was woven into cloth—some of it elaborately patterned.

Archaeologists, excavating Montezuma's Castle in 1923, uncovered a baby burial made more than five centuries before. The infant had been interred in his little blanket of hand-woven cloth, which still showed plainly the exquisite workmanship and the infinite care and patience of some loving woman.

Nell Murbarger photo

◀ **The rich bottomlands** of Beaver Creek and the Verde River were tilled by the prehistoric farmers who inhabited Montezuma's Castle

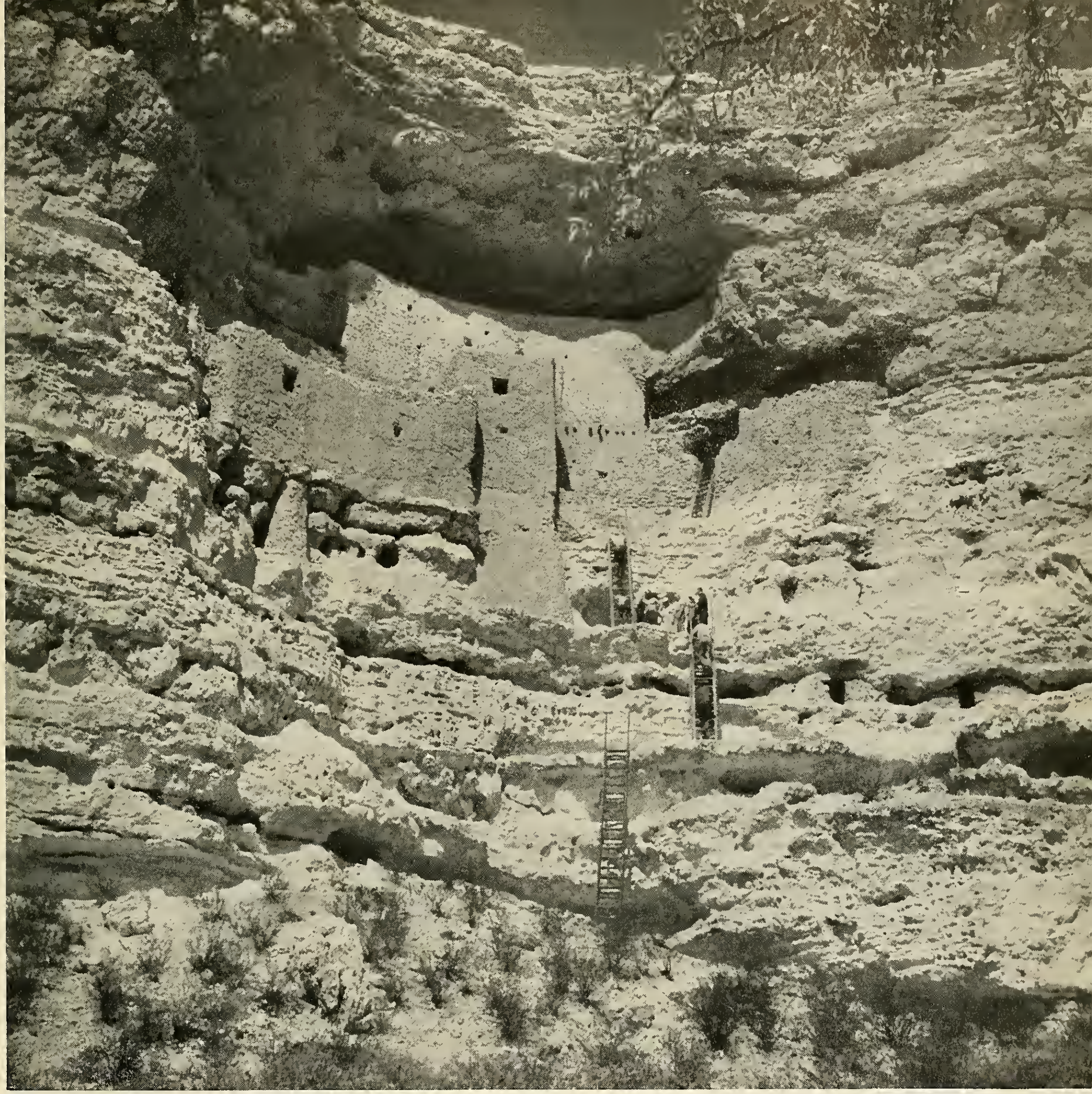
A Glimpse at Yesterday

The opportunity to visit this wonderful place came to me last year in October. Equipping ourselves with a booklet, we set out on a journey of discovery. Interesting shrubs, trees, and archaeological features en route had been marked with numbered stakes, corresponding to numbers in the guidebook which served to interpret and explain.

Stake No. 7 brought us to an amazed halt.

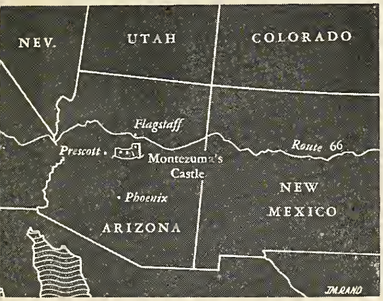
"Behind this stake," explained the guidebook, "is a large ground floor room. It is one of over 40 rooms which once made up this great six-story cliff dwelling. The building was destroyed by fire several hundred years ago . . ."

We hadn't previously realized that any tangible evidence remained of that grand structure which originally had contained twice as many rooms as the immense pink castle



Nell Murbarger photo

▲ NINETY PER CENT INTACT after about 900 years, Montezuma's Castle stands as one of the Southwest's most magnificent building projects of prehistoric times



100 yards to the east. On the floor of the room, presumably as some Indian family had left them, lay a couple of primitive milling stones—a trough-shaped metate and a small mano.

Another few steps along the cliff's base took us to a cave designated by park authorities as the Charnel House, and a short distance beyond lay the cemetery.

Nothing about this primitive burying place is remotely suggestive of a modern mausoleum; yet, strangely speaking, that was its function. The limestone ledge, crossed by the trail, originally extended out to form a roof over seven graves, all of which were carefully sealed by slabs of limestone. Excavation of the seven graves produced parts of fifteen skeletons. The accepted theory is that the cliff dwellers became crowded for cemetery space and were forced to shovel out old graves to make room for brethren more recently departed. Evidently not too

National Park Service photo

▲ Montezuma well, a natural spring. Several well-preserved cliff dwellings can be seen in the upper portion of the wall encircling the "well"

much care was given to removing the complete skeleton.

Continuing along the fascinating, sycamore-shaded foottrail, we soon found ourselves back at the point of beginning, where a ranger informed us that the first nine persons who arrived would be accommodated on the first tour.

The ladders by which one reached the castle proved to be thoroughly well made and sturdy. We had wondered how visitors could be restrained from entering the ruin unescorted. The answer lies in the second ladder, which extends over a portion of the cliff unscalable except possibly by alpinists. Strong shutter-like doors were folded over the ladder from either side, effectually covering the steps. Only after this contrivance had been unlocked by the ranger's key and the shutters laid back was it possible to proceed up the cliff. Only three persons at a time were permitted on any of the ladders.

With all our party safely up the fourth ladder, we entered the first of the castle's rooms. Coming, as we did, from the glaring sunlight, this tiny cubbyhole seemed to possess more of the attributes of a dungeon than of a castle. It was long and narrow and windowless, save for two small portholes in the front wall just above the floor line.

As our eyes became more accustomed to the semidarkness, we could see that the original wall surface was heavily coated by the smoke and grease of countless cookfires. Multiple fingerprints of the ancient builders were visible in the adobe plaster, where they had been impressed centuries ago while the material was still fresh and yielding.

From this room we passed into others, both larger and smaller. One of them was barely six feet square and so low that none of our party—not even the nine-year-old youngster—could stand wholly upright in it; yet smoke-blackened walls indicated that it had been used for dwelling purposes. All the rooms were poorly lighted, and while many southwestern cliff dwellings are provided with holes to permit the escape of smoke, these had none.

On the west coast we consider sycamore one of the less durable woods, roughly comparable to poplar or willow. How was it then, I asked, that these centuries-old beams were still sound and nearly as hard as marble? The ranger agreed that sycamore wood is quick to deteriorate in a wet, humid climate. "Here in the aridity of the desert, however," he explained, "it is almost impossible to place a time limit on its endurance."

While the ceilings of the rooms all varied in some degree, the general plan seemed to consist of one or two main beams, about a foot in diameter, laid lengthwise. Across these beams were smaller cross rafters. These, in turn, were covered with a thatch of willows or grass and finally with a layer of hard-packed mud. In this manner, the ceiling of one apartment became the floor of the one above. In some rooms, the willow withes had been fastened in position by strands of yucca fiber; and in one room, the thatching medium appears to be corn leaves.

What became of these people? No one knows. Possibly the sporadic attacks of warring tribes from the north increased in fierceness and frequency until it was no longer possible for the cliff farmers to till their fields and produce food. Or, possibly, long centuries of use brought exhaustion to the soil, as has happened since the world's beginning and still is happening where men farm with more attention to the present than to the future.

One factor that may certainly have contributed to the pueblo's abandonment (and perhaps the chief factor) was the unhealthful conditions engendered by dark, smoky rooms, serious overcrowding of population, and absence of all sanitary facilities.

Such remnants of the population as remained on the Verde in the fifteenth century are believed to have made their way north to the Hopi villages, there to be assimilated by the friendly tribe with which they had long previously established trade relations.

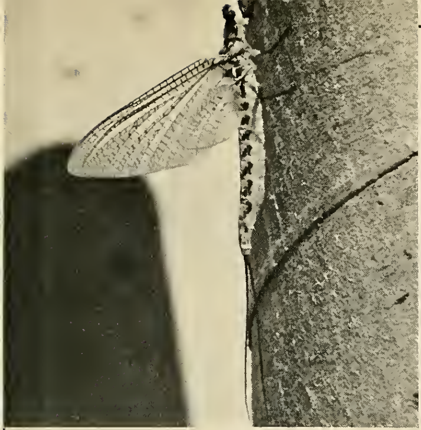
As we left the mellow old castle and started the return pilgrimage down the ladders, it came to me with some surprise that I was still completely in the dark on many of the questions about this place that had so long puzzled me. Sometimes I wonder if it isn't pretty much as the late Frank Pinkley, "Boss Ranger" of the National Park Service, once observed.

"The known history of Montezuma Castle," said Mr. Pinkley, "is especially interesting . . . because there is so little of it."

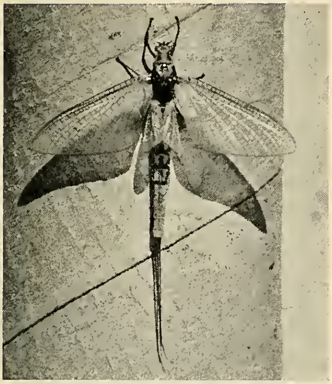
A May Fly
SHEDS ITS SKIN

The only insect to molt after acquiring fully developed wings performs for the camera

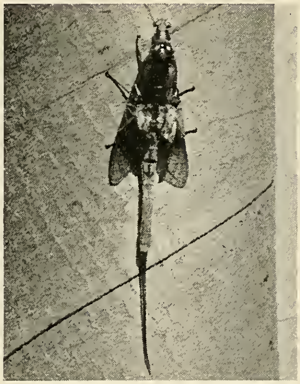
By Janice Hintz



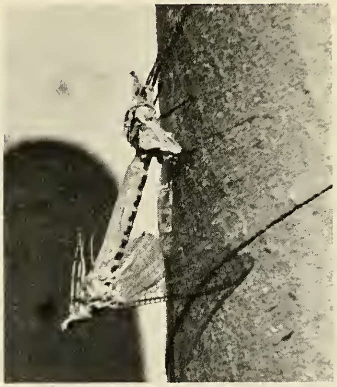
▲ Here we see the May fly in its natural position, with wings held upright. This stage is called the subimago and precedes sexual maturity



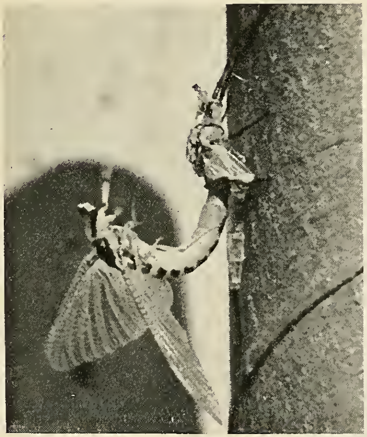
▲ First Step: Just before the May fly starts to shed its skin, it puts its wings down flat and then flits for a minute or so



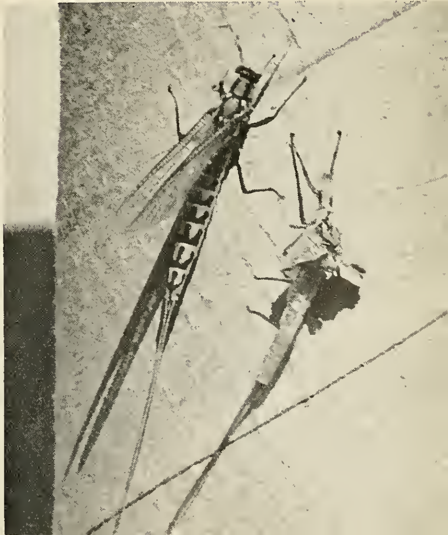
▲ Second Step: The skin between the wings splits, and the May fly pulls its thorax and head out of its old casing



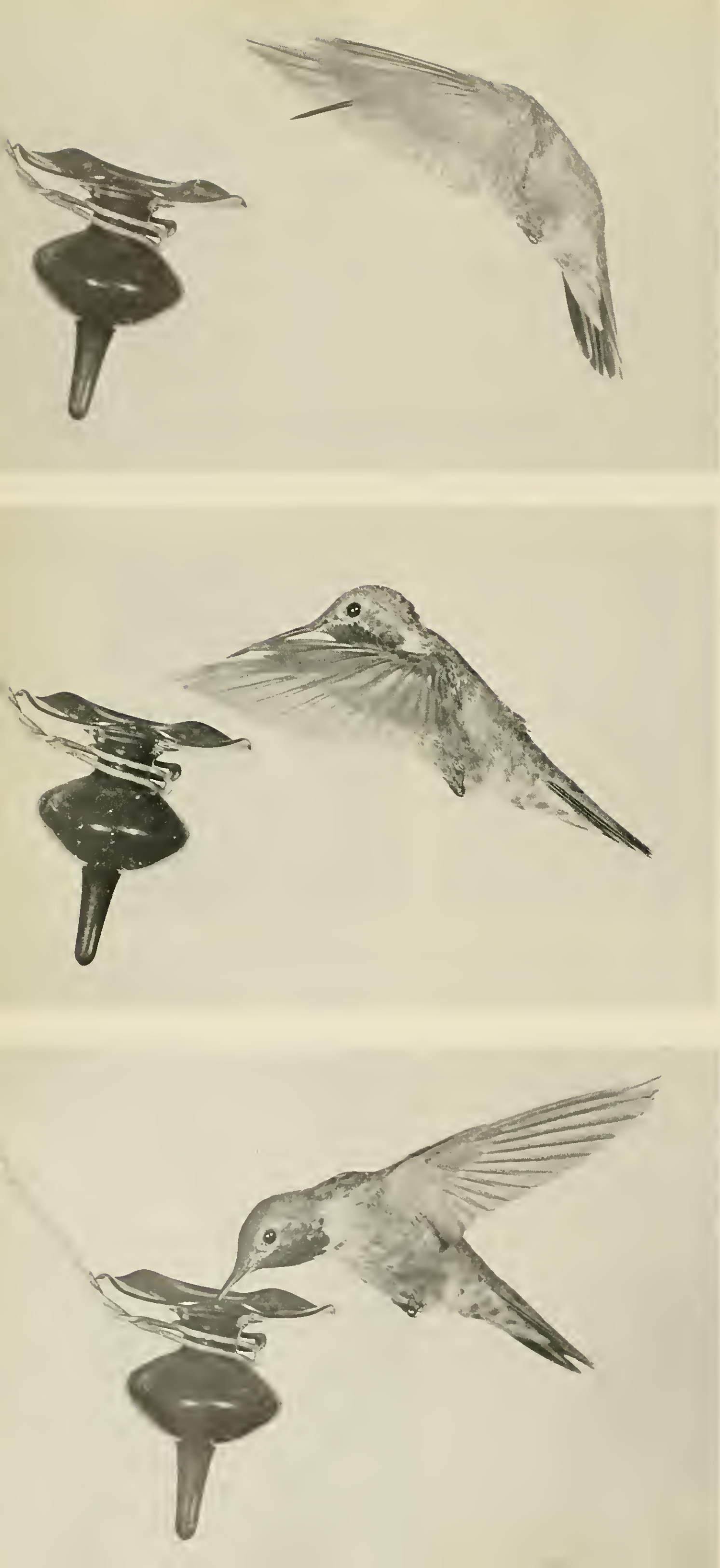
▲ Third Step: After the May fly has freed its wings and body, it does a back flip. It hangs as if it were dead for a few seconds



◄ Fourth Step: Then it struggles to get upright again. It took this May fly five minutes to shed its skin



► All Finished! The May fly emerges from its ghostly skin, shiny and beautiful. Its wings glisten like golden cellophane. The insect waits beside its dried, crumpled skin until evening. Then it flies away into the night



Whistlin

THE male Broad-tailed Hummingbird has the distinction of possessing a characteristic that sets him apart from all other birds within his range. All hummingbirds make a humming sound in flight. That is why they are called hummingbirds. But the Broad-tailed Hummingbird may be identified instantly by his unique trilling or whistling sound. He is nearly always heard long before he is seen.

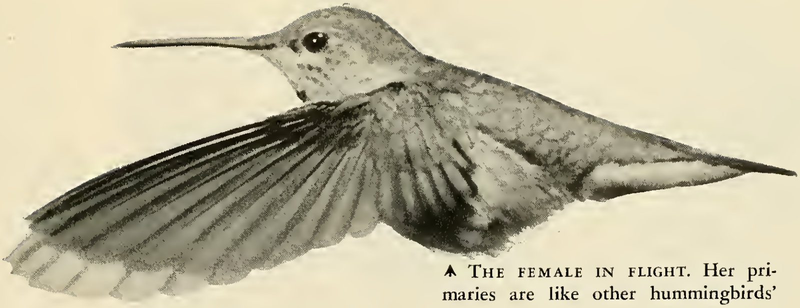
To the observer hearing it for the first time and seeing the bird in action, this seems definitely to be of vocal origin. It has been variously described as "a shrill trilling," "a shrill screeching noise, something like that produced by a rapidly revolving circular saw when rubbed by a splinter," or "a curious, loud, metallic, rattling noise."

Close observation shows that the intensity of the sound is correlated with the rate of vibration of the wings. There is little or no sound when the bird hovers before a flower, the vibration rate then being about 55 beats per second. It is distinctly audible in ordinary level flight, when the beat rises to 75 or thereabouts. And it is loudest in the dive-bombing courtship display, when the rate has been estimated to be as high as 200.

The accompanying pictures are high-speed electric flash shots taken

◀ These three photographs of a male Broad-tailed Hummingbird approaching a syrup cup show the feathers that cause the whistling sound. The first two, or outermost primaries, are shaped differently at the ends, forming a slot through which the air whistles

Wings



▲ THE FEMALE IN FLIGHT. Her primaries are like other hummingbirds'

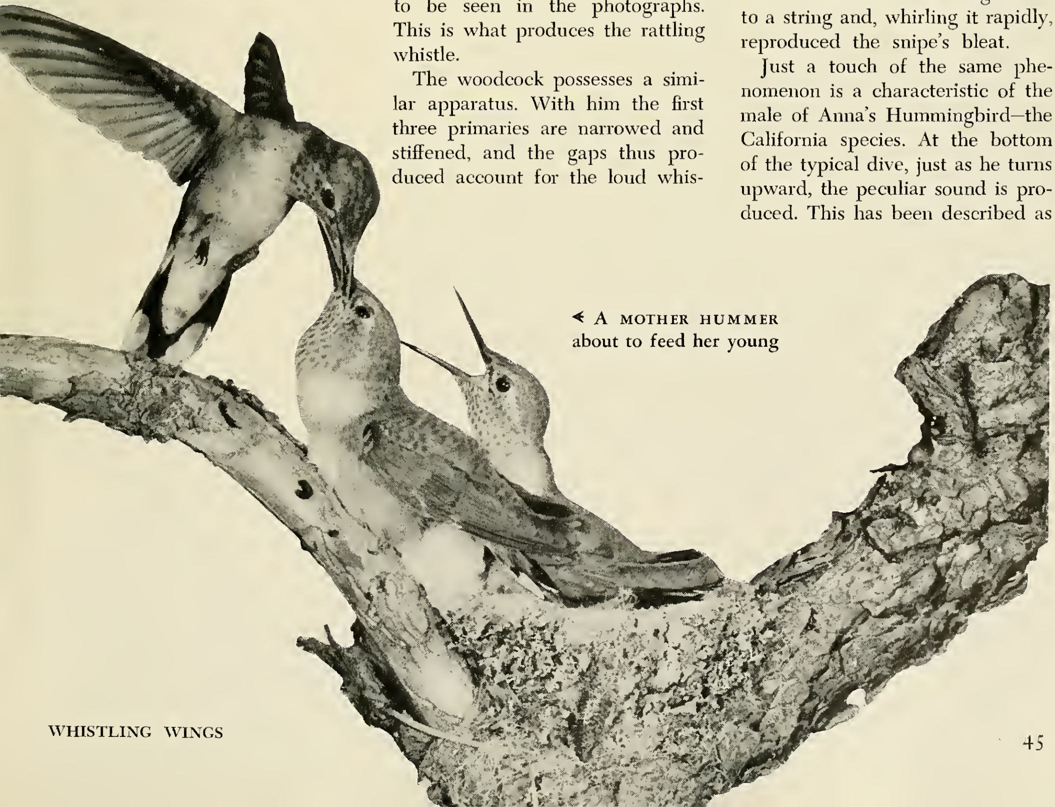
Though he may not sing a note, you will hear the Broad-tailed Hummingbird before you see him, and you need have no doubt as to who he is

By WALKER VAN RIPER *and* ROBERT J. NIEDRACH
Denver Museum of Natural History

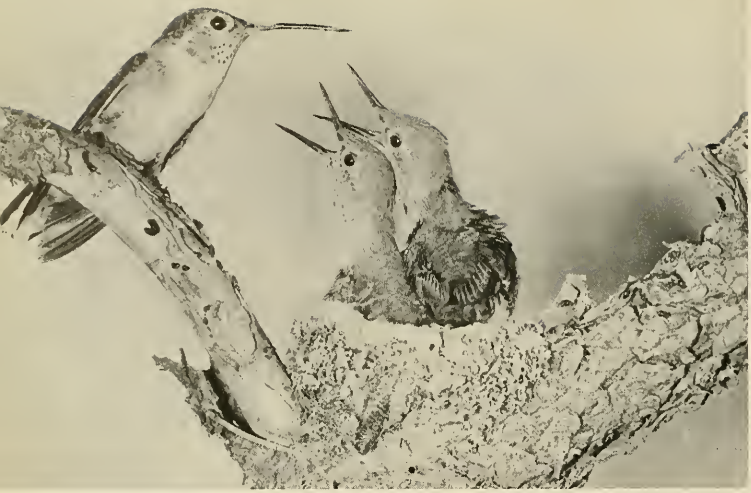
with the apparatus invented by Dr. Harold E. Edgerton of M. I. T., with exposures of about 1/10,000 of a second. They illustrate the differences between male and female wings and at the same time explain the source of the sound. The female in flight makes only the usual buzzing or humming sound of the hummingbirds. When her wing is spread, it is clear that all the primary feathers are normal in shape. In the male, however, the first two or outermost primaries are uniquely modified, being narrowed at the tips to produce the little gap to be seen in the photographs. This is what produces the rattling whistle.

The woodcock possesses a similar apparatus. With him the first three primaries are narrowed and stiffened, and the gaps thus produced account for the loud whistling accompanying the flight love song. This whistling, too, has often been mistaken for "voice." Another bird with modified feathers that produce a characteristic sound is the snipe. In the courtship flight the bird rises to a great height and then plunges earthward in a terrific nose dive, emitting a weird noise that has been likened to the bleat of a goat. That this strange noise is produced by the peculiarly formed outer tail feathers was demonstrated by a Danish naturalist many years ago. He fixed the tail feathers in a weight tied to a string and, whirling it rapidly, reproduced the snipe's bleat.

Just a touch of the same phenomenon is a characteristic of the male of Anna's Hummingbird—the California species. At the bottom of the typical dive, just as he turns upward, the peculiar sound is produced. This has been described as



◀ A MOTHER HUMMER about to feed her young



▲ THE "NORMAL" shape of her wing feathers is seen from this photograph of the female hummingbird feeding her children on the wing. These pictures were taken at about 1/10,000 of a second

a *klip*, *plip*, or *speek*, or as resembling the "bark of the California ground squirrel." It has been shown that this is due to a narrowing and bending of the outermost tail feathers.

The Duke of Argyle, in his *Reign of Law*, demonstrated (by a logical, not an observational, process) that "no bird can ever fly backwards." The hummingbird, he said, might appear to do so when leaving a tubular flower, but in reality the movement is a fall rather than a flight. Many observers, however, have contradicted this statement, and there is not the slightest doubt that hummers can fly in any direction—up, down, sideways, forward, and backward. The bird shown in the accompanying photographs feeding her babies on the wing actually flew backward and a little upward to attain this position. She ordinarily lit beside the nest and began feeding the young, but if she were frightened a little by the camera or the photographer, she would take wing and continue the feeding operation from the position shown. Of the many hummers watched by the writers, this is the only one ever seen to do this trick.

LETTERS *Continued from page 2*

nated "pommel" for the firm purchase of one's finger, and also (apparently because the blowhole was thereby plugged) to make certain that the air-breathing animal would not submerge while being ridden.

W. H. HODGE.

Amherst, Mass.

Blind Fish

SIRS:

Robert R. Miller, in his article "Desert Fishes" appearing in the December issue of NATURAL HISTORY Magazine, doubts the discovery of "authentic blind fish in the fresh waters of western North America," and asks for reliable information to the contrary.

Dr. Miller has evidently overlooked *Anoptichthys jordani*, a blind characin. This fish was discovered in a cave in San Luís Potosí, Mexico, in 1936. Professor Carl L. Hubbs identified it as a new species, probably descended from *Astyanax mexicanus*. This was reported by the New York Zoological Society and the New York Academy of Sciences.

Jordani is about three inches long, is a pale translucent pink, and has rudimentary buds in place of eyes.

ARTHUR M. BLUM.

Brooklyn, N. Y.

Dr. Robert R. Miller of the University of Michigan's Museum of Zoology comments as follows:

I much appreciate the interest shown by Mr. Blum. The expression "western North America," as I use it, includes only the Pacific and Interior (Great Basin) drainages of North America. I am familiar with that remarkable blind characin, *Anoptichthys jordani* and with two closely related species, *A. antrobius* and *A. hubbsi*, described recently from limestone caves in the same region. This area lies inland from Tampico, in San Luís Potosí and Tamaulipas, in the drainage basin of the Río Pánuco, which is an Atlantic tributary. It might also be pointed out that there are two blind catfishes known from the vicinity of San Antonio, Texas, in almost the same longitude as the Mexican blind fish. Again, however, the subterranean waters drain toward the Atlantic.

Let us continue to hope that someone will find blind fish from the Pacific drainage of North America.

A Woodsy Odor

SIRS:

My secretary, Mrs. Helene Gonzales, who happens to be a member of your Museum, called my attention to the front-page article in the *Herald Tribune* reporting the unique idea of scenting NATURAL HISTORY Magazine with a pine fragrance.

Permit me to compliment you; I think the idea is a splendid one. . . . As a hobby, I am immensely interested in the educational phases of our olfactory sense. I find that children are easily stimulated by novel and unusual odors within the aesthetic field, and their comments and reactions are very revealing from a psychological point of view.

For this December you appropriately selected Pine, which is so pleasantly reminiscent of our Christmas Festival. Would it not be possible to scent subsequent copies with specific and exotic plant derivatives and at the same time associate the scent with an interesting story about the particular plant? . . .

ALFRED H. MOELLER.

New York, N. Y.

SIRS:

As a friend and also as a subscriber to NATURAL HISTORY Magazine, I will look forward to receiving my pine-scented copy, reminiscent of the fragrance of the pine woods. . . .

M. FRED CARTOUN.

New York, N. Y.

SIRS:

. . . Regarding the odor impregnation of NATURAL HISTORY, of which I happen to be a subscriber, it may be of interest to you that the process of perfuming magazines originated with me way back in 1937 . . . in *New Ideas*. The print order was 75,000 copies, and the odor was quite strong after one year. We decided against pine and a number of others, using instead a sort of fruity odor, which we knew would last longer. . . .

Hugo Gernsback.

New York, N. Y.

Sirs:

I have read with great interest of the printing of Natural History with pine-scented ink. I am wondering whether it would be possible for us to try a similar venture here at the Eaglebrook School. We have a most unusual press and printing department and are located on a mountainside surrounded by pines. The Eaglebrook School Press is run exclusively for the students. . . . Would it be possible to obtain some of the ink through your printers? No more than a pound would be necessary for our paper at Carnival time next February. . . . I am sure our students would be greatly pleased and their interest in the graphic arts stimulated.

Richard Dyer,
Director.

The Eaglebrook Press,
Old Deerfield, Mass.

(A pound of the pine-scented ink is on its way to the Eaglebrook printers, with the compliments of Natural History Magazine.—Ed.)

Sirs:

Being greatly interested in your initiative in printing an edition of Natural History with scented ink, I write to ask whether it would be possible for you to send me a sample of the Magazine. . . .

Jean Alexandre.

Algiers, Algeria

Dear Meester:

Please send mine next month widout the synthetic pine from de Maine vuds!! De "brand" from de cactus in de pine vuds—so pretty on de cover—is especially irritating to my nasal membranes! I sneeze! I headache! I find most perfumes quite irritating to my skin. . . . So please . . . send my next copy widout. Thanks.

Mrs. Sigmund Epstein.

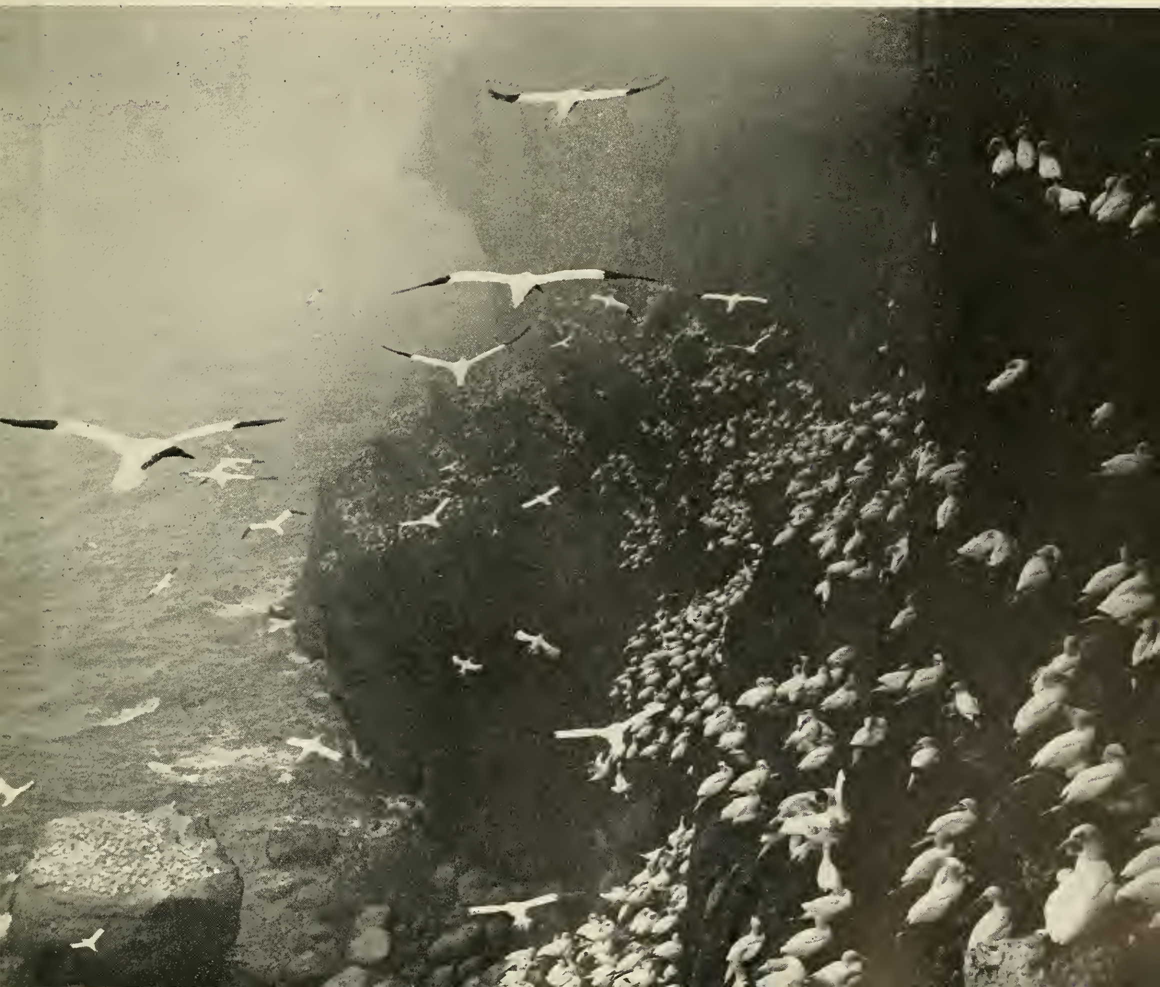
P.S. I apologize, too, to all those who enjoy and like perfume.
New York, N. Y.

From the Press

"The staid American Museum of Natural History has beat the whole magazine publishing field at its own game. . . ." (New York *World Telegram.*)

"This week subscribers unwrapping their December copies of Natural History were pleasantly surprised. . . ." (*Newsweek.*)

It . . . deserves, we think, the attention and the delighted anticipation of the literate world." (New York *Herald Tribune.*)



Fish-divers through the mist: Gannets of Bonaventure Island in the Gulf of t. Lawrence, brought to us by the distinguished bird photographer, Allan D. ruickshank

THE MAORIS WERE OUR HOSTS

Continued from page 14

◄ **Sir Peter and Lady Buck,** with others of the party, in the place of honor during speeches of welcome. Each meetinghouse is identical in plan, but they vary in design

food as we could eat. At all the feasts that we attended, the food was delicious and abundant. More than that, the joy of hospitality written on each host's face at every pa was beyond anything of the sort I have ever seen. Watching those generous men and women, one was ready to find excuse for the fact that 100 years ago in Maoriland people were sometimes eaten instead of being fed. Was it so much worse to eat an enemy than to torture him with living death as the whites have done: the rack, the stake, the third degree, or the agony of the last war?

In nearly all the village feasts, the food was cooked outdoors in pits—steamed with hot stones—chicken and every kind of meat and fish, including the Maori dish of eels. Once we were served the royal dish of pigeon. It made me sad, conservationist that I am, because the number of wild pigeons is very much depleted. There were vegetables and salads, and brilliant-hued desserts. Everything was good.

At Te Puea's pa, in the evening, an ordinary dance was attended by both whites and Maoris. Without native clothes and rhythms and bare feet, the Maori boys and girls were not a whit more graceful than if they never took their part in the beauty of their native dances.

The floor was cleared shortly after our arrival. The girls took off their shoes and changed their party dresses to bend to unseen paddles in the lovely swaying of the canoe poi dance, their chanting rising and falling to the poi balls, which sounded like paddles in the water. It was the dance of the Tanui Canoe, one of the Fleet whose several canoes are to Maoris what our "May-flower" is to us. As the dance progressed, dancers bending, poi balls flying, the leader called for quicker, quicker motion: "I see New Zealand! All the power in your human bodies give to these paddles! Land is there!" Every gesture had its meaning in the story. One dancer even depicted a bird that flew past the canoe.

After leaving Ngaruawahia we drove to Rotorua, in the thermal district. From the hill above the lake, we could see the wooded island to which Hinemoa swam to join her lover. We drove through the town past the Maori village of Whakarewarewa, where the people cook over thermal heat and wash in thermal water cooled enough to touch. Here geysers shoot, mudholes boil, and the ground steams. The heat came through my walking shoes, but the Maoris walked there barefoot. Sometimes a child has fallen into the boiling pool from which no person could be saved alive.

We drove to Horahora. Outside the gate a sacred stone is a guide to all the actions of the villagers: the Hinengawari Stone. Out of deference to our waiting hosts, we laid green leaves upon it.

This was a simple pa. The meetinghouse served also as a school. On the wall I saw a childishly-drawn picture of Santa Claus dressed in his furs but in the summer setting of December way "down under."

We visited every kind of pa all over the East Coast, where sandy, golden beaches curve between great headlands. Sometimes the children danced. Once a group of youngsters aped their elders, with one small rascal in a flax skirt to his ankles sticking out his tongue, grimacing, rolling up his eyes in perfect mimicry of older warriors. We saw action dances, boasting dances, furious war hakas, games. Often there were jesting dances, with fun in every movement. These made me wonder if some of the rock pictures found by scientists were done in humor, too. There is one in the Christchurch Museum of a female figure with exaggerated arm and fingers, a real "come hither" picture.

"Dr. Buck," I asked, "do you think that some of those old paintings found in caves are funny? Has any anthropologist ever written on their humor?"

"No," he said "but you can."

I can't imagine Maoris not having a good time, whether they were drawing on the rocks 600 years ago or dancing in their villages today. A child, a wonderful old grandmother with tattooed lips and chin, those so fat they ought to waddle—all enjoy their fun.

Except in sorrow. I saw one boy with arms around a weeping older woman. I have a Maori friend who cannot find a comfort left in life since she lost two children. Everywhere I went among them there was kindness for my deafness such as sensitive people feel.

The study of alien peoples should be far more a part of education than it is. Children would lose the strangeness when learning the similarities and differences of other races. Anthropologists today, in their new and human approach, have already created friendship, co-operation, and interest in their scientific research with the very people they study. It is one more way to bring the world together.

February NATURAL HISTORY *1950*

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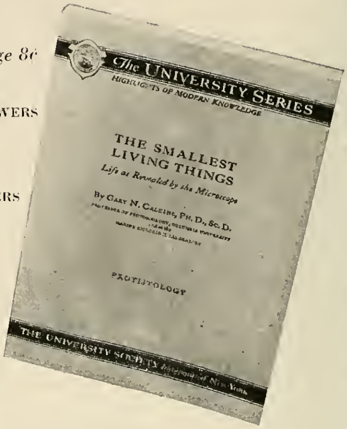
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LETTERS

Siamese Trees

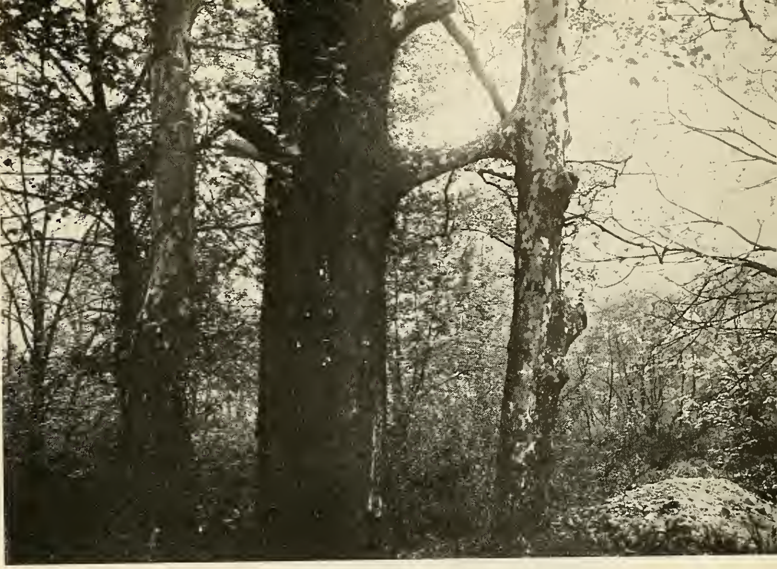
Sirs:

Readers of Natural History Magazine might be interested in these two trees, which have become joined together. They have been thriving for at least 20 years. This curious sight can be seen immediately south of Rutherford, New Jersey. The trees are on the west side of the River Road along the east bank of the Passaic River, a short distance north of New Jersey Route S3.

The link between the two trees is well over head-high, and you will note that some of the limbs have been trimmed so that the trees can show their strange connection to passers-by. Both are sycamores. The grafting of the limb of one tree to the trunk of the other must have taken place naturally.

C. J. Bates.

Englewood, N. J.



Longer Evenings or Shorter Days

Sirs:

If December 21 or 22 is the shortest day in the year, can you tell me why the sun begins to set later each night a week or so *before* that date? This question came up when some of us were discussing the proper date for the end of the year.

The Nautical Almanac shows that the sun reached its southernmost point on December 21 and started north on December 22. But the sunset was at its earliest from December 2 to December 14 in 40° N. lat. So the evenings were getting longer before we reached the shortest day in the year. At the same time, the tables show that we do not get the latest sunrise until after the shortest day—from December 30 to January 12. Could you please explain this?

Herbert R. Spencer

Erie, Pa.

Most persons never notice, as Mr. Spencer has, that the shortest day in the year does not *seem* like the shortest day in the year. But the sunlight we have begun to gain in the afternoons prior to December 21 is being lost in the mornings, as his letter implies. This is due to the fact that clocks and watches do not agree with the sun. When your watch says it is noon, the sun may be about a quarter of an hour on either side of its highest position. You can easily prove this by comparing your watch with a sun dial. At one extreme, on November 6, the sun dial will tell you it is noon when your watch reads 16 minutes 19 seconds before noon. At the other, on February 11, the sun dial will register noon when your watch says it is 14 minutes 25 seconds past noon. This difference between clock time and sun time is called the *equation of time*. The eight-shaped figure on some globes, which is known as an analemma, tells the amount of this difference at any time of year.

The reason for this varying discrepancy is that the earth moves at a varying speed in its elliptical orbit around the sun. It happens that around the shortest day in the year, the sun and your watch are quite close together. But during the preceding weeks, the sun has been ahead of your watch and is "slowing down" to meet it. This gives the impression that the afternoons are getting longer, instead of shorter. Of course, if you time the *rising* of the sun each day, you will see that the mornings are getting shorter. In fact, they are losing sunlight faster than the afternoons are gaining it.

After the shortest day in the year, the sun continues to fall behind your watch, and because the day actually *is* getting longer, it appears to be lengthening more rapidly than is the case.

In the tropics, where the length of day varies little, the equation of time really "takes over." Hence on the equator the sun begins to set later in the early part of November!—Ed.

North America's Most Violent Quake

Sirs:

I note in your September issue of Natural History some very interesting correspondence regarding earthquakes.

While making surveys in 1927 for a natural gas pipeline from Monroe, La., to St. Louis, our line passed through the southeastern part of Missouri near New Madrid. My attention was called to the so-called earthquake or subsidence that occurred in that section in 1813.

It was reported that the surface settled from ten to twenty feet and that the Mississippi River flowed both ways into an underground cavity. Reelfoot Lake in Tennessee was reported as formed at that time. Further investigation disclosed a U. S. Government report on the subject, I think by the U. S. Geological Survey, which gave many details of the "subsidence." The report quoted data furnished by an English botanist who was investigating the flora of that region and who was present at the time of the "quake."

I conferred at the time with a Jesuit priest, a seismologist at the University of St. Louis, who was in charge of the University seismograph. He spent several hours with me, gave me a five-page report on the subject, and furnished me with a map on which the area affected was outlined.

His seismograph had indicated recent vibrations. He stated that brick chimneys in Paragould and Jonesboro, Arkansas, were still being damaged. His advice was, "Stay out of that country or build a rubber pipeline." The good man was pleased to have someone consult with him on a practical question such as the location of a natural gas pipeline.

This fall we were on a trip up the Mississippi River on the Greenline Steamer "Delta Queen." As we neared New Madrid, we were furnished a bulletin giving the following information regarding the "quake":

"The steamer 'New Orleans,' built by Robert Fulton and sponsored by Nicholas Roosevelt of New York, a great-uncle of a later president, was the first steamboat to make the trip down the Ohio and Mississippi Rivers to New Orleans. Incidentally, she never made the return trip due to lack of power and excessive draft.

"Nearly sixty miles down river from Cairo, Captain Roosevelt noticed that his boat was going upstream instead of down, although his engines were set to propel her toward New Orleans.

"A forced landing was made but no reason for the strange reversal of the current could be learned. The river flowed upstream for three days and nights.

"When the boat stopped at New Madrid, it was learned that a great earthquake, of non-volcanic origin, had occurred near New Madrid, and the upstream flow of the river was due to its filling a great underground cavity. Today this crevasse is known as Reelfoot Lake."

I would greatly appreciate hearing from Mr. L. Don Leet, Seismologist at the Harvard University Seismograph Station, as he probably has more detailed information on the subject.

Frank H. Shaw

Lancaster, Pa.

The following comments are offered by L. Don Leet, Seismologist in Charge of the Harvard University Seismograph Station, at Harvard, Massachusetts:

The series of earthquakes to which Mr. Shaw is referring were probably the most violent of any known in North America during the period covered by our historic records.

These so-called New Madrid earthquakes were in 1811 and 1812. The first large one occurred at about 2 A.M., December 16, 1811. The second, of similar magnitude, was on January 23, 1812, and the third on February 7, 1812. For at least a year there were smaller shocks of varying intensity every few days. The region has been subjected to intermittent activity since that time and is regarded as one of the relatively few in the United States in which there is probability of major destructive earthquakes.

The geological environment of these shocks accounts for many of the spectacular surface changes and may be connected with the forces that produced the quake. The region is at the tip of what is known geologically as the Mississippi Embayment, and topographically it is the St. Francis Basin. The Basin is filled with thick river flood-plain deposits of unconsolidated alluvium and is bordered on the east by deposits of loess—very fine-grained dust deposits accumulated by a combination of wind and river action. The heavy shaking of a major earthquake causes landslides, slumps, and extensive general movements in such materials.

Some land areas sank as much as 15 feet, though amounts of 5 to 8 feet were more common. Some of these areas then flooded and became lakes, with the remains of trees dotting their bottoms. Reelfoot and St. Francis are two such lakes. One area, known as the Tiptonville Dome, 15 miles long by 6 to 8 miles wide, was raised 10 to 15 feet above the level of the highest floods.

Elevation here and settlement there, combined with extensive landslides along the banks, resulted in very turbulent conditions in the Mississippi. Strong upstream waves (similar to miniature tidal waves) and associated currents gave the effect of the river flowing upstream. Such conditions may have been repeatedly observed, but I question the report that the river "flowed upstream for three days and nights" to fill Reelfoot Lake. There was a large element of hysteria and superstition intermingled with on-the-spot reports of those days. These included mysterious flashes of fire (lightning from thunderstorms in the vicinity) and sulphurous fumes (marsh gases released by the disturbed swamp areas). The effects were widespread and spectacular but not mysterious.

The largest shock produced vibrations in the ground strong enough to be felt in such distant points as Boston, 1100 miles away. The quake was felt from Canada to New Orleans and from the headwaters of the Missouri to the Atlantic—a total area of about one million square miles.

Hands Across the Sea

SIRS:

Some of the members of our Dutch Youth Association for Nature Study have wanted to start correspondence with young people in various parts of the world. This month we received our first request for an address in the United States. The Dutch Natural History Society suggested that we write to the American Museum of Natural History. We have heard of your wonderful magazine, NATURAL HISTORY. Our members are 12 to 23 years old, corresponding members 16 to 23. We would be very grateful if you would send us the addresses of any young people who might like to correspond with our members.

Hans Andreae

Nederlandse Jeugdbond
voor Natuurstudie
Lammenschansweg 47
Leiden, Holland

Any readers of NATURAL HISTORY between the ages of 16 and 23 who wish to establish contact with Hollanders having kindred interests are encouraged to write to Mr. Hans Andreae at the address given above. —ED.

Palms

SIRS:

As a long-time member of the American Museum, and for several years a member of the Fairchild Tropical Garden, I have been hoping to see something about the Garden in NATURAL HISTORY. There was such a reference in Walter Henricks Hodge's article on Palms in your November issue, but it implied that this is Dr. David Fairchild's own garden rather than one named in his honor.

For many years, Dr. Fairchild had worked toward the establishment in subtropical Florida of a place for the collection and study of tropical trees and shrubs. The organization was incorporated under the laws of Florida and has 850 members. The purchase of the 83 acres of land and the erection of most of the buildings was financed principally by Col. and Mrs. Robert H. Montgomery, whose place a mile south of the garden contains some 400 species of palms—the largest collection in the United States.

I would call special attention also to a feature of Fairchild Garden not mentioned in the article—the 25 acres known as Montgomery Palmetum. More than 300 varieties of palms can be seen there, and the number is being increased every year.

A final word as to the total number of palm species, which Prof. Hodge estimates at nearly 3000. Dr. Liberty Hyde Bailey, addressing a group at the Fairchild Tropical Garden on January 11, 1946, said he had seen estimates ranging from several hundred to 11,000 and added: "No one can say just how many species there are, but I personally am familiar with more than 5000. And they are not mutations of the same or similar palms, but differ from one another as a robin differs from a bluebird."

Leonard Ormerod

Miami, Fla.

Does the Cat Come Home?

SIRS:

In the November 4, 1949, issue of the *Herald Tribune*, the following story appears:

"Hayti, Mo.—Yellow Jack, a tomcat, was back with the Clemons children today after a 600-mile, four-month walk from Michigan. Part Persian and the rest just plain alley cat, Yellow Jack originally lived in Benton Harbor, Michigan. Three years ago the cat was brought to Hayti and took a liking to the five Clemons children. His owner took him back last July. He stayed one day in Benton Harbor, Michigan, then disappeared, presumably walking around lower Lake Michigan and down the length of Illinois to the Clemons home in Missouri, arriving on November 3."

Can this story possibly be true?

Amy G. Shuey.

Jackson Heights, N. Y.

The following comments are offered by Dr. Frank A. Beach, Professor of Psychology, Yale University:

If a cat can walk 600 miles, then the story might "possibly be true." By this I merely mean to imply that Yellow Jack could, conceivably, start in Benton Harbor, Michigan, and eventually arrive in Hayti, Missouri, simply as a matter of chance. After all, thousands of cats must be lost or deserted each year. It is not too much to expect that a fraction of one per cent of this total will accidentally take a course that brings them home.

Continued on page 95

NATURAL HISTORY

The Magazine of the American Museum of Natural History

F. TRUBEE DAVISON, President
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In charge of Publications
ALBERT E. PARR, Director

VOLUME LIX—No. 2 **FEBRUARY, 1950**

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You will find NATURAL HISTORY Magazine indexed in *Readers' Guide to Periodical Literature* in your library

THE COVER THIS MONTH

The largely epiphytic ("tree-sitting") family of the Bromeliaceae is one of the most characteristic and exotic groups of plants indigenous to tropical and subtropical America. Strangely, a single species hails from Africa. "Spanish Moss," (*Tillandsia usneoides*) and the economically important Pineapple are the best known members of this interesting family. Visitors to the Caribbean countries may become acquainted with the plant whose portrait appears on the cover – Pinguin (*Bromelia Pinguin*). Pinguin, or *Piñuela,* as it is sometimes called, is pineapple-like in general appearance and in its terrestrial habit. Its thick, mealy-white spike bears white to pale rose flowers. These mature into yellow, plum-sized fruits with a pleasant though slightly acid taste. The succulent leaves, often six feet in length, possess fine, strong fibers, which are often utilized by aborigines in the tropics for a number of domestic purposes. Probably the most important use of Pinguin today, throughout its range, is as a dooryard plant to form living fences. The sharp, stout teeth that margin the leaves are formidable obstacles to man and animal.

W. H. HODGE

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YOUR NEW BOOKS

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AMERICAN INDIAN SCULPTURE

----------- by Paul S. Wingert

J. J. Augustin, $7.50
144 pp., 7 figs., 76 plates

ALL too frequently are we presented with a discussion of primitive art that combines sound art criticism with anthropological sophistication. Mr. Wingert is an art historian with strong anthropological leanings, and his present book is an important contribution both to fine arts and to ethnology.

The general title is, unfortunately, misleading, since this handsome volume is actually a highly specialized study, dealing almost exclusively with the wood sculpture of the Salish tribes of Washington and southern British Columbia. Although these fine carvings have heretofore attracted little attention as compared with the more elaborate productions of the tribes farther north, Salish art is a mature and developed tradition, representing, perhaps, an earlier basic style out of which Northwest Coast art grew.

Salish wood sculpture consists of carvings in the round and in relief, most of which were of a religious nature and were associated with shamanism. Mr. Wingert wisely discusses these objects against the broader background of Salish culture generally. The body of the book is concerned with a classification of the carvings and with the delineation of tribal and regional styles. The author recognizes five subareas of Salish art, within which he postulates ten "style centers" and seven "major traditions" (based on style and technique). In a cautious historical analysis, he favors an inland, or upriver, origin of Salish sculpture, perhaps in the region occupied by the Duwamish tribe of central Puget Sound.

Although the book is a scholarly study intended primarily for the specialist, it should make fascinating reading for anyone interested in American Indian art. The excellent photographs, many hitherto unpublished, provide a mine of material for the art student and designer. The rigid stylization and stark simplicity of Salish sculpture echoes recent trends in modern art, and the best pieces compare favorably with the now well-known productions of West Africa and Oceania.

HARRY TSCHOPIK, JR.

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A NORTH CAROLINA NATURALIST—H. H. BRIMLEY

Selections from His Writings

----- edited by Eugene P. Odum

Univ. of North Carolina Press, $3.50
205 pp., 44 illusts.

THIS book is prepared as a memorial tribute to H. H. Brimley, native of England, who served as a respected employee of his adopted State from 1884 to 1946. In preparing this volume, the approach was to use selected papers from his writings on history and natural history, which were in the files of the North Carolina State Museum. They were prepared by Mr. Brimley in the course of his work to build a Natural History Museum that would attract visitors and teach the fundamentals of the natural sciences.

The selected papers were organized by the editor into six groups, based on chronology and subject matter. To this the editor adds a biographical summary that carries H. H. Brimley in his vocation from youthful naturalist to retirement as Museum Director. The editor has a note introducing each of the groups of writings for the purpose of biographical continuity.

These papers range from commercial egg-collecting in 1880, commercial wildfowling on Currituck Sound, Cape Hatteras, in 1906, the early State Fairs, hunting and fishing episodes, early waste and later conservation of wildlife resources, a native whale fishery, sharks and their behavior, the story of mammoth and mastodon remnants, interesting native birds, and the development of the State Museum until 1928.

Altogether, this is a commendable effort to record the works of one man during a long career. Many admirable facets of a lovable character are not included. Friends will like this book for personal reasons. Students will appreciate a new view of North Carolina during the first half of this century.

HARRY T. DAVIS

ABBE DAVID'S DIARY

----- translated by Helen M. Fox

Harvard Univ. Press, $5.00
302 pp., 16 illusts.

THE Catholic missionary Armand David was one of the great plant and animal explorers of the nineteenth century, and the records of his travels are scientific documents of great value. He was not only a dauntless explorer but a good naturalist who brought back large collections from remote regions of China. To the American layman, he is best identified as the man who "discovered" the giant panda, a remarkable bearlike creature. The extensive diaries of David's three journeys were published in France during the eighteen-sixties and seventies. These journeys lasted four and a half years and took him over much of northern, central, and eastern China.

The present attractively printed and illustrated volume is an abridged translation of the first two journeys; the diary of the third one was not included because the translator considered it less interesting. I disagree on this point and urge completion of a task so well begun.

David wrote with unusual simplicity and clarity, and his writing has not suffered in the expert hands of Mrs. Fox, who, as a matter of fact, demonstrates her own ability in a brief biography of the missionary. The diaries include many interesting observations on plants and birds, and the mammals and other animals are not neglected. David was a good general observer and recorded much of interest about China; unfortunately, lacking the ability to view things celestial from a broad point of view, he made many unduly harsh statements about the Chinese. To his credit, he was dauntless in the face of sickness and other severe discomforts.

Names of Chinese localities and technical names of animals and plants have not been handled well; only some of the former have been changed to the form familiar in English, and only some of the latter have been brought up to date. It would have been better to change all of the place names and leave the animal and plant names just as David used them. A list of

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by Alfred M. Bailey

An all-color picture of New Mexico, filmed by a famous naturalist in a land of unsurpassed beauty.

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by Wanda Mills

STEPPING STONES IN THE PACIFIC *February 25*
by Alfred M. Bailey

SOMETHING'S ALWAYS HAPPENING IN THE ZOO!
by William Bridges *March 11*

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by Karl Robinson

WILDLIFE IN ACTION *April 8*
by Dr. Olin Sewall Pettingill, Jr.

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recent equivalents could have been combined with an index, and a map certainly should have been included.

CLIFFORD H. POPE

THE COAST OF NORTHEAST GREENLAND

----------- by Louise A. Boyd

American Geographical Society, $6.00
356 pp., 16 maps, 179 figs., plus illustrative material

IN 1937 and 1938, Louise Boyd organized and directed expeditions so that she might continue her exploration of East Greenland. Profiting by her earlier experiences, these were planned with the same objectives in mind. They gave Miss Boyd and the scientists accompanying her the opportunity to explore the coastal zone from King Oscar Fiord, about 72 degrees N., up to Isle de France, 78 degrees N. The report of this work was well along in its preparation when the war broke out. Because a wealth of information about this area was of extreme strategical importance, all the photographs of this and Miss Boyd's earlier expeditions were turned over to our Government and held as restricted information until after the end of the war. After the restrictions were lifted, the reports were finally completed and presented as a special publication of the American Geographical Society.

The sea ice coming down from the Arctic Basin presses in along this part of the coast so as to prevent access by sea throughout most of the year, occasionally throughout the entire year. Because of sudden shiftings in the position of the ice, an expedition in this area must be able to change position and perhaps objectives very rapidly. The expedition in 1938 had a much more favorable season than that of the previous year. An important part of the report has been contributed by Richard Foster Flint, who was the geomorphologist in 1937. He described, and in some cases surveyed, several of the more important glaciers of the area. The results are similar to those in other parts of Greenland. Most important is the fact that the ice mass is in a state of deglaciation at present. The difficulty in interpreting some of the recently formed features should serve as a warning to those investigating Pleistocene problems in other areas. Similar studies were continued in 1938 by Bronner. In his report, more attention is given to the petrology of the area, particularly the metamorphic and igneous rocks. An outline on page 217 is the only attempt to present the geologic history.

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The reports on the ecology, botany, and hydrography, including current and tide observations, contribute greatly to our knowledge of the region.

The outstanding feature of the work as a whole is its wealth of illustrations. Miss Boyd has described a technique whereby topographic maps are made from the photographs. Photography seems to be Miss Boyd's first and now her primary interest. Because of her ability, the photographs, both from a scientific and artistic point of view, make the most important contribution to the final report. Many readers of varied interests must commend the scientists and editors for presenting such a readable and informative report.

RALPH L. BELKNAP

THE STORY OF MAPS

----------- by Lloyd A. Brown

Little, Brown and Co., $7.50
397 pp., 84 illusts.

BECAUSE of well-fulfilled responsibilities concerned with maps and cartography at the University of Michigan, the Peabody Institute in Baltimore, and the Johns Hopkins University, Dr. Brown was the man to undertake this work of eminently readable scholarship. He calls it a co-operative venture, but the molding of complex data into simple and beautiful form is his own high accomplishment. This is no book to read in tired moments but rather, for the sake of its thread and charm, in a period of sustained and alert leisure.

The story begins with the daybreak of history, when the earth was taking shape to inquiring man. His early concern was with what he regarded as the habitable world, but speculation soon outran that, and the growth of knowledge became, so to speak, a reflection from the stars. In other words, sound theories of geography progressed along with comprehension of solar and other cosmic phenomena. Accounts of important early contributors, in a chapter entitled "The World of Claudius Ptolemy," have remarkable freshness and clarity, even though the author deals here with subjects and personalities already dimly familiar. Ptolemy (second century) well stated a famous scientific principle, usually credited to William of Occam (fourteenth century), namely, that the best explanation of any kind of phenomenon is the simplest possible hypothesis that does not conflict with the observed facts.

The author's treatment proceeds with chapters on the Middle Ages, the task of haven-finding, the trade in maps and charts that followed the invention of printing, the problems of latitude and then of longitude. The art of determining the last-named component of a geographic fix marked one of the greatest steps in the history of exploration and mapping. It depended upon the introduction of two pieces of apparatus—a telescope and a reliable timekeeper — and scientific cartography may be said to have been born in France during the reign of Louis XIV. Cash prizes of the eighteenth century for means of more accurate determination of longitude at sea (within half a degree or 30 nautical miles) were in amounts up to $100,000 or more. They outdid the bounty of modern radio advertising!

The two last chapters of this book deal respectively with the survey of a country and of the world. They cover mainly the last century and are replete with surprise. As recently as World War II, it was discovered that the earth had scarcely been mapped at all in relation to strategic needs, and that "antiquated" charts, long relegated to library files, were worthy of the utmost respect. A forecast of these circumstances appears in the Introduction to this book, wherein Dr. Brown indicates the ephemeral existence, deliberate concealment or destruction, and high frequency of loss of important maps through the ages.

The book is illuminatingly and excitingly illustrated and superbly documented. It is the kind of dateless source that one must turn to again and again.

R. C. M.

AMERICA THROUGH BRITISH EYES

---------- compiled and edited by Allan Nevins

Oxford University Press, $6.00
530 pp.

I DON'T think it need be emphasized that most people, as well as most nations, have a natural curiosity to know what others think of them. There is, however, a social restraint that tempers the fully candid expression of the way our friends and acquaintances feel about us as individuals which is frequently absent in the impressions that travelers publish about a country. As nations more readily than as individuals, we can enjoy the "giftie . . . to see oursel's as others see us."

We Americans certainly can hardly feel slighted in this beneficence, as Mr. Nevins' book amply demonstrates. The pleasure of contemplating ourselves through the eyes of our British visitors from the beginning

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of the Republic to 1946 is indeed a fascinating one. If we shrink at having our warts, pimples, and deformities described in all their horrid detail, we can expand with the encomiums heaped upon us. Irritation at the misjudgment of our guests can be balanced by the blush from undeserved praise. Then there is always the solid satisfaction of recognition in the just and penetrating analysis.

Mr. Nevins' anthology is a remarkably catholic one, drawing from the well known like Dickens, the Trollopes, Bryce, and Wells and from the forgotten writers who, despite their literary obscurity, often made shrewd or amusing observations. He has assembled his excerpts to cover a vast variety of topics, from pigs in the streets of New York to the cultural manifestations of the nation, from slavery to prohibition, from social customs and manners to political institutions. We catch glimpses of our great; we travel across the country in coaches, river boats, and Pullman; we stop at log cabins, country inns, and de luxe city hotels; we are amazed at our women and appalled at our children; we see our countrymen soberly and industriously at work, full of kindness and good deeds, and avid for literature, and then, with a flick of the page, find them sprawling, lazy, lawless, moving only to spit tobacco juice, and dead to all culture. The choice of excerpts is designed not to shield our sensibilities but to reveal ourselves in the variety of ways in which we appeared to these literate travelers.

Mr. Nevins has divided his samples into five periods, each preceded by a summary analysis of the attitudes displayed by the contemporary writers. Although some themes continue throughout, it is interesting to note the change in orientation as the United States grew in complexity and power. Perhaps the most abusive period was from 1825 to 1845, which Mr. Nevins calls one of Tory condescension. Here is where the notorious book of Mrs. Trollope falls. It is, perhaps, unfortunate that the most virulent attacks upon us have been best and longest remembered, for there have been many notably accurate and sympathetic appraisals of our national character from British pens.

In reading so many accounts of the same subject, one cannot help being impressed by the degree to which each writer unconsciously projects his own personality. Often they are more revelatory of the author's prejudices and conditioning than they are of the object's characteristics.

Although the editor refers to the undiminished flow of British books on American travel, I found on the contrary an interesting pattern in the frequency of their appearance. The bibliography contains almost 400 titles, selected by Mr. Nevins to cover all of the most important items. Although these do not exhaust the list, I tabulated them according to their date of publication and discovered a gradually increasing number, with a maximum of 47 titles in the decade 1850-9, falling thereafter to a minimum of 12 titles in 1890-9 and 12 in 1900-09. In the twenties a minor revival occurs with 33 titles, followed again by a sharp drop. It is tempting to speculate on this curve of production. Does it represent cyclic phases of special interest in us by the British? Or is it merely the effect of developments in transportation?

H. L. Shapiro

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by VICTOR WOLFGANG VON HAGEN

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MAN IN THE PRIMITIVE WORLD

-------- by E. Adamson Hoebel

McGraw-Hill Book Co., $5.00
543 pp., 73 figs.

THE rapid increase in the teaching of anthropology in colleges within the past few years has been accompanied by the appearance of excellent textbooks—so many, in fact, that authors seem to be running short of appropriate names. This title seems a little ambiguous. This most recent book by Hoebel is a comprehensive treatment aimed at undergraduate students and average readers. As anthropology becomes more and more a subject to be taught to undergraduates, and perhaps eventually to high school students more books of this type will be needed.

The book is divided into five parts. Part One is a brief definition of anthropology and a discusion of the subsidiary disciplines. The history of man and his culture are outlined in Part Two. Part Three discusses the races of mankind and gives a very adequate and well-balanced presen-

Continued on page 96

Those Barotse!

An epic journey by a band of African natives, who walked 500 miles in starvation, peril, and exhaustion to join their white friends

By MARGARET HUBBARD*

Hubbard expedition photos by Arthur Mencken and George Noble

▲ COURAGE, HONESTY, AND UNDYING LOYALTY are some of the qualities that win admiration for the Barotse. N'Yambe is here shown bringing long grass to make a camp bed

WE had sold to the Pretoria Zoo all the animals collected during eighteen months in Northern Rhodesia. It was a blow, for we once had hoped to bring them to zoos in the United States. But we were broke. Then our spirits were lifted by a friend's offer to back us in another try, and this time we were also going to take moving pictures of the game.

After months of preparation, all was ready for our move to the fabulous west–to the country beyond Namwala on the Kafue flats, beyond Kowetu, out in the spaces empty of villages toward Mankoya, where the game was thick and undisturbed. Out there, hunters told us, the lions walked boldly at four in the afternoon; and Sajetema, the father of all elephants, whose tracks one knew by the crack across his right hind foot, roamed immune from harm. If he heard natives chopping wood, he came on the run to toss and trample them to death for daring to invade his kingdom; and should a man fire on him, the bullets would turn to water. Or so the natives said. The region sounded like a paradise of game, ideal for our purpose.

We planned to make a base camp close to water, where there was shade and a breeze and where we could plant a vegetable garden and make a home of sorts for the children. If your son were born in Northern Rhodesia and had known nothing but the freedom of the high veld and the constant watchfulness of a devoted nurseboy, it would not seem alarming to go still farther into the bush; so I had no fears. By that time, I was well versed in precautions and the technique of nursing malaria and dysentery; the babies were fit and the rest of us in good condition.

As to lions, leopards, and such dangers, I had learned that the difficulty is to find the brutes instead of fearing they might find us. After all, I reasoned, if great-grandmother once rode horseback from upper New York to Iowa, and if others once took their children across the Great Plains in the face of hostile Indians, why couldn't we go into a wilderness where only the animals were wild and shy? No. We discounted imaginary dangers and took precautions against what few risks there might be. If game were there, as hunters said, we would find it and produce the pictures. If we had a worry, it was about the capacity of the cameraman coming to do the photography. He was the risk, not the game or the country.

We had not considered the impact of another venture such as ours. Far to the north another American had photographed animal-catching by methods so crude and cruel that Africa was shocked and outraged. And although for two years we had had permits to capture animals for zoos, the Governor responded to public opinion and stopped all such operations in Northern Rhodesia. To this day, our predecessor's pictures may not be shown in Kenya.

Yet what of our organization and our hopes and plans? No matter what had happened to the north of

< NO TASK was too dangerous or exhausting. *Left to right*: the seventy-year-old Mudalla, who grew "very hungry"; Shilling, who would give his life for the babies; Mengeneera, who tossed a deserter over the fence; and Johnnie, who died of "witchcraft"

∀ A BAROTSE on tom-tom

us, we could not give up. This opportunity was our bonanza.

At last we were given permits to photograph and capture what game we wished in Portuguese East Africa, in a territory northwest of Tete on the Zambesi River, where game conditions were said to be unexcelled.

We had, of course, no choice. Surrender was impossible; and at the time no other area was open to us, although the journey would eat into the dry season and the expense of it was an added burden. Nor did we know anyone who had been into the area to confirm the reports of the game, nor did the officials back in Lourenço Marques have any idea of traveling conditions. This was before there were motor roads, and the shortest route to Tete was by rail to Shamva in Southern Rhodesia and thence a walk of about 300 miles overland. From Tete we could work upcountry another 100 miles to the Ruio-Capochi district, wherever that might be. In the opinion of the Portuguese officials it was back of beyond.

Much as we wished, the expense of the move made it impossible for us to take with us all our most dependable boys. After long thought and difficult choice, we named five. I put Tickie first, the nurseboy whom I had trained to care for the babies; then Capaso, the washboy, who doubled as cook, nurse, tentboy, or in any other task about camp. Mengeneera was indispensable as a hunter, and Johnnie was a strapping, fearless Barotse. Charlie, the headboy, ran a peaceful compound and, moreover, came from Portuguese territory, so he was needed.

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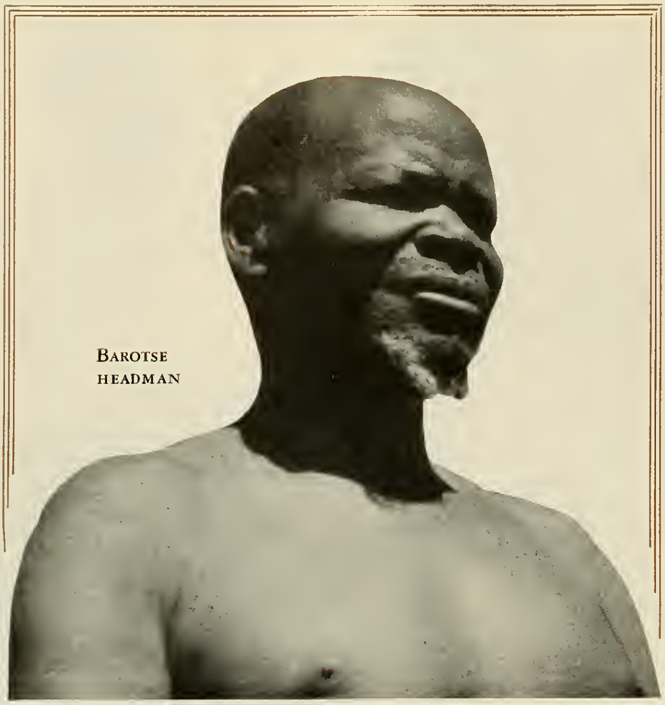
*MARGARET CARSON HUBBARD has covered Africa from the Cape to Cairo. She has lived in various parts of the continent for years at a time, and her son was born in a mud hut at Tara in Northern Rhodesia. Mrs. Hubbard has written two books on Africa, *No One to Blame* and *African Gamble,* and has made motion pictures of the animal and native life in Northern Rhodesia. She worked with Military Intelligence on African areas and has served as Vice Consul and Economic Analyst with the U. S. Legation in the Union of South Africa.—ED.



Barotse headman

The faces of the others dropped when we gave them the decision. But the next morning seventeen came to us with their thoughts. Mafaeking, another Barotse, stepped forward to act as spokesman. He was an upstanding man with an open face and a determined chin.

"We understand the railroad costs too much money for all of us. But we do not wish to stay behind. If we walk to where the Inkos leaves the railroad, may we go with you? You will need carriers, and we will carry."

"Walk?" We were dumbfounded. As the crow flies, it was all of 300 miles from Choma to Shamva and nearer to 500 or 600 miles by the trail they must follow. There were mountains to climb, up and down the hard escarpment; the Zambesi Valley had to be crossed, where the natives were truculent and big game a possible danger; and then there was another climb to the plateau and Shamva. When they reached us, there would be still another 400 miles to cover, yet they suggested this jaunt of nearly 1000 miles as though it were no more than going down to the corner store.

"You will need carriers," Mafaeking persisted. The group behind him nodded vigorously. "If you can give us salt and tobacco to buy food, we will come. We do not want to be left behind."

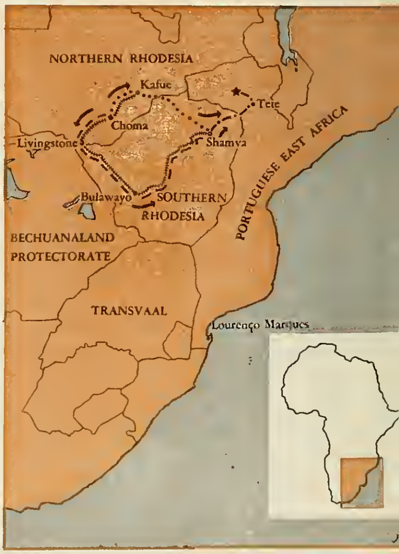
It was not high wages that were luring those boys. We paid most of them the standard ten shillings a month and their food, which could be matched by any employer in Northern Rhodesia. They had more meat to eat in our hunter's camp than on the average farm, but no one, surely, would walk 1000 miles for meat. The fact remained, however, that they wanted to stay with us and we wanted them—the cream of the compound, most of them of the Barotse tribe.

Mafaeking was a good hunter and a good worker. Matches, about seventeen years old, was my cheerful tableboy. There was Saiman, who had a way with animals; and even the Mudalla, of the crumpled shoulder, where a lion had bitten him. He was 70 if he was a day, but the old man grinned and assured us that the walk would be a mere nothing for him. There was his devoted brother, Shilling, and Kapatan, Towelo, Momborowa, and others—the boys we would have chosen if we could have afforded to take them.

Leaving day approached, and we measured out more than enough coarse salt and tobacco to see them through their long trip, and a few shillings apiece to take them up the railroad a short distance to cut 100 miles off their walk.

Two weeks later the railroad was behind us and we were camped on the Mazoe River, in Southern Rhodesia, busily organizing for the long walk to Tete. Our first need was carriers, 50 or 60 of them, to move all the duffel we needed to see us through and to establish headquarters and take pictures—camp equipment, rifles, ammunition, cameras, film, a few clothes, our own food, and food for carriers. A 200-pound bag of meal fed 50 boys for two days. Trade goods—calico, beads, and salt—were needed in quantity to exchange for food on the road, and in addition we would have to carry some meal to feed our boys

▼ From Choma, the natives followed t dotted line, the expedition the dashed li



◄ KAPATAN (*right*) and another Barotse stripping bark to make ropes before the heroic journey into Portuguese East Africa

▼ MAKING HEAD RINGS from bark for carrying loads

in case we struck a barren area. No one in the district could tell us of conditions on the trail, for no one had made the trip, nor had they heard of anyone who had walked to Tete.

Boys poured into camp from Nyasaland and other points north, looking for work on the mines. Many of them would have taken work as carriers, but when we said we were going to Tete, they lost interest. They would not go into Portuguese territory.

A rough lot, about 20 of them who said they were of the M'Curry Curry tribe and natives of Southern Rhodesia agreed to go with us. But within a few days, when our trade goods began to disappear, we were certain that we faced trouble. There was a thief, or thieves, among them, and our lives depended on having calico and salt to exchange for food. Yet there was no alternative but to keep them on for the sake of their legs and shoulders, which could move our duffel. No boy worth his salt would go into Portuguese East.

One week went by, then two and three, and we began to worry about our Barotse. They should have reached us, unless some misfortune had delayed them.

We had uncovered the thief and put the fear of God into him, but we needed those Barotse more than ever, as a sound core to the good-for-nothings we were forced to hire. Three hundred miles of unknown country lay ahead of us, where there was not a white man, policeman, or magistrate within days' reach, should we need authority to deal with troublemakers. Nor could we desert those boys, although we had no means of knowing where they were, what had happened, when, if ever, they would appear.

Witchcraft! The dread word shuddered through camp when Johnnie, the big, fearless Barotse, discovered he had a tapeworm. Without a doubt, some boy in Barotseland, hundreds of miles away, had put a spell on him. So many things carry death—the chameleon, the rabbit, a snake in the house, a certain kind of snail—before which the boys would cover their eyes in horror and run away. They spoke in whispers, for to speak aloud of the evil would court disaster; nor was it named.

Johnnie thought of his past, thought of someone in his faraway village who bore a grudge. There was no convincing him that he was not doomed, and no word of ours, nor the fact that the worm was removed, put heart into him. Not one boy in the entire compound believed our reassurances. Witchcraft! And there was no witch doctor who knew the medicine to lift the spell. What can a white man know of magic? Ours were empty words, and they watched him, fearfully waiting. The will to die possessed the boy, and when the stars marched across the sky to meet the dawn, Mengeneera came to whisper, "*Ena feelee* [He's dead]."

Johnnie's brothers, the Barotse, had not yet arrived, but Capaso, Mengeneera, and Charlie buried him as a Barotse should be buried. They knew in what position Johnnie should face the east—his legs drawn up as though in his mother's womb.

Of all those in camp, I was the only one who could not pay my last respects, for Johnnie was a man and I a woman, and a man's burial is the business of men. Afterwards, I put a stone on the sad pile of rocks that protected the grave from hyenas and other scavengers, and I had in my throat the same thick lump from which every one of us who knew the boy was suffering.

Five weeks had now gone by, and each day we spoke of the many things that could have happened to the boys we waited to see. At the beginning of the sixth week, when I was looking, as I so often did, up the road by which they should approach camp, I saw some boys coming down the hill, their feet dragging in the dust. Surely it could not be the vigorous boys I knew! They were thin and tired, but nonetheless they were our boys.

Weak voices greeted us. "*Dabonwa Inkossikos. Mabouka Boss.*" They sank wearily to the ground, and Mafaeking stepped forward. "*Ena feekilee, Inkos.* [We have arrived.]" We clapped our hands in response to their greeting and waited. They were skin and bones. They had been on the way for six or seven weeks.

"Did we not leave plenty of trade goods?"

"Oh, yes." Again Mafaeking stepped forward, but his shoulders drooped, his face was grayish-brown and drawn. Slowly he told the story.

The morning after we took the train, the storekeeper in whose care we had left what was to be sold, came to the compound and saw the sacks of salt and tobacco and laughed at the boys for liars when they told him we had left those things for them to use on their trip. They would walk to Shamva to join us, would they, and we believed it? We were fools, and he knew natives well enough to know that the thieving bastards would not keep their word. He confiscated the salt and tobacco.

"We had said we would come," Mafaeking continued gravely. "As we said we would do, we took the train to Kafue and started our walk from there. You had given us money for our tickets, and the storekeeper did not know we had it."

They reached the Zambesi Valley and found the villagers starving after a bad year. There was very little grain, and what little they would part with, they sold at a price. A blanket for a mere double handful of grain! They spent the few shillings they had saved from months of pay. They sold their blankets, their shirts, their shorts. They went on starvation rations, but even so they twice lived for three days at a time on roots and grass and water.

"We saw much game!" Mafaeking's eyes shone for an instant. "Where the Kafue and the Zambesi meet, we saw elephant with tusks so long." He measured his arm from his shoulder. "Many of them."

He went on: "The dogs we were bringing you died of starvation, but six puppies were born on the road, and Saiman, caring for them when he had food, saved three."

The whimpering little bags of bones crouched in a bark basket, which he had carried for weeks on an empty stomach. He laid them at my feet.

Shorn of blankets, money, everything but the rags they stood in, they had reached Sinoia, in Southern Rhodesia, and had gone to the Native Commissioner to ask for word of us. All during their journey they feared that we might have given up hope and gone. The Commissioner at Sinoia knew nothing of us, nor of our journey, but they were detained for two weeks. First they were vaccinated.

"We understood that," Mafaeking explained. "We know that all boys coming into Southern Rhodesia must first be scratched against the sickness. But when that was done, we were not allowed to leave." Mafaeking's voice was bitter. "The Bwana made us work. He fed us, but he did not pay us, and he told us you must have gone and that he would find work for us. He told us that if we did not work, we would be sent back to Northern Rhodesia

◄ A FIGHT in Barotseland. In a crisis, 17 Barotse subdued 60 natives of other tribes to quell a mutiny and see the expedition safely into Portuguese East Africa and that we would have to walk again through the Zambesi Valley. Many white men came to see us. They said they would give us fifteen, twenty shillings a month to work on their farms. Barotse are known." Mafaeking drew himself straight, and pride rang in his voice. "We said that we had work, with you. We said that you would not leave us. So at last we were allowed to go. We have walked seven days from Sinoia, and now we have arrived. That is all."

To look at their gaunt faces was to know that every word of the story was true. Matches looked ten years older—no longer the plump, laughing youngster I had left in Choma. Only the wrinkled, seventy-year-old Mudalla looked much as he had. He still clutched his bundle of spears and still wore at a cocky angle the same wreck of a straw hat with a feather in it. More than once in his life he had pulled his stomach against his backbone, and it would take more than a hungry 600-mile walk to finish him. "I am very hungry, boss!" He clutched his stomach and spread his sardonic grin.

Matches dug down into his *chiapaupau* and brought out a plated silver teaspoon. "You forgot this in Choma, Inkossikos," he told me. "I brought it to you."

I could have cried. He might have traded the spoon for a square meal and I would not have known, or cared.

"Thank you." What was there to do or say in reply to the saga of complete loyalty? We gave them blankets, clothes, the money they had spent, and told them to eat and sleep until they felt like moving. Every face wore a smile. "Thank you, Inkos!" *They* thanked *us!*

Even grief over Johnnie's death could not darken for long their zest for living. They had been hungry, but they were no longer. They had been afraid, but the dangers were past. In three days, they said they were ready to go, and when the packs were lined up, it was those Barotse who took up the heaviest, most awkward bundles.

"Hi! Yi! Yi!" The shrill yips and shouts of laughter, with which they always started a journey, echoed against the hills across the river. "To Portuguese! To Portuguese! *Yi! Yi! Yi!*" Saiman, Matches, Kapatan, and Tickie took up the crib in which the children rode. We were off!

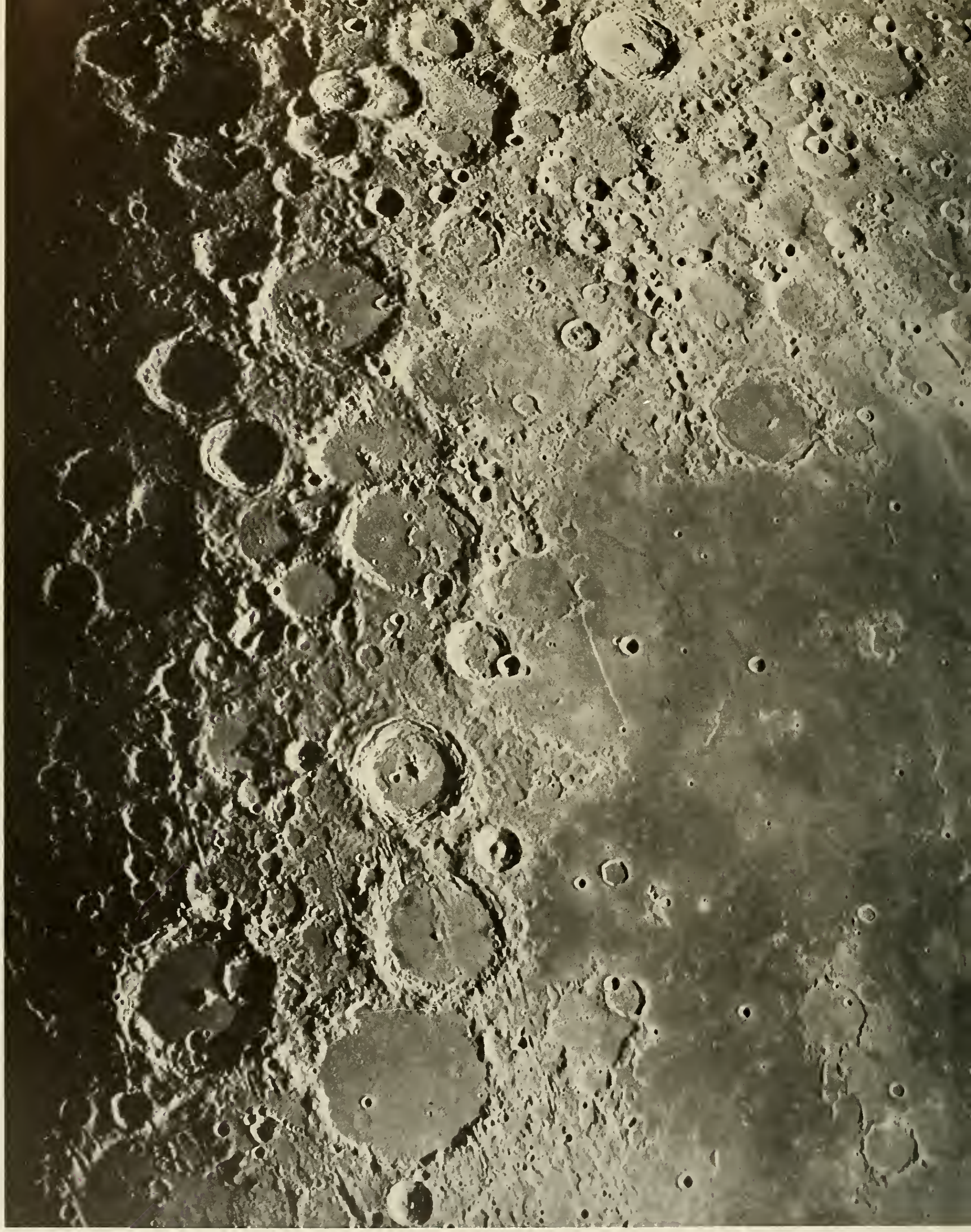
Two weeks later, we should have been well into Portuguese territory, but we had not yet crossed the Luio River and the border. In this rugged, rocky country food was scarce, and we had to trade exorbitant yards of calico for what we could buy. Some villagers even covered the water holes until we paid to learn where they were hidden. We lost days hunting for meat, as most game had left the dry country. Our trade goods were perilously low, and there was muttering among the M'Curry Curry. Without food, and plenty of it, those boys would not carry 60 pounds apiece for many more days, and without carriers we would be stranded days from any place.

We climbed down, down, down from the plateau and came, at last, to a sandy river bed, the Luio. Great oval marks were pressed deep into the sand. Elephant! We wound

Continued on page 93

▲ Kasonda taking a bird from a snare

◄ Kasonda shows the typically open, cheerful face of the Barotse



▲ DARK SPOTS, suggesting a low but persistent form of vegetation, are observed on the floor of the crater Alphonsus (where the arrows would meet). They are known to vary. This is in the south-central portion of the moon

How Dead

Is The Moon?

Strange occurrences observed by astronomers indicate that the question of life on the moon is not a "closed book"

By Paul M. Sears

Photographs courtesy of Mt. Wilson Observatory

THE moon has long been considered a dead world, airless and lifeless—a world where nothing ever happens. Yet puzzling events occur on the moon, as its devotees well know—events as real and unquestionable as changes on Earth from "fair" to "rainy" or from summer to winter.

However, earthly comparisons are misleading, for the moon's climatic excesses are far greater than the rigorous extremes of our deserts, poles, and high mountaintops. The moon's atmosphere is so thin that its existence is still occasionally doubted by scientists—though not by those familiar with the moon from many nights of observation.

The lunar atmosphere has a surface density only one ten-thousandth that of ours, a gaspingly thin prospect for space explorers. Yet this meager moon-air diffuses the advancing light of the sun and casts a pale dawn over the dark and frozen regions beyond the "terminator"—that is, beyond the line that divides night from day on the moon. To see these elusive dawns and twilights requires patience, knowledge, and rare good fortune. Ten favored astronomers in the last 150 years have glimpsed the lunar dawn as a faint prolongation of the bright horns of the crescent into the dark-moon disc, on nights of exceptional seeing, with the "old moon in the new moon's arms."

Not only twilights demonstrate an atmosphere on the moon. Far more spectacular proof has appeared recently with observations of bright moving specks against the "old moon," which must be luminous meteors in the lunar air. These were discovered not by chance but by careful deduction and painstaking search, reminiscent of the effort that resulted in the discovery of the planet Pluto.

The search was based on the knowledge that eight or ten meteorites strike the Earth each day, while many millions of smaller ones are consumed as luminous streaks in our atmosphere, yielding only a fine metallic dust which drifts down upon us steadily from the stratosphere.

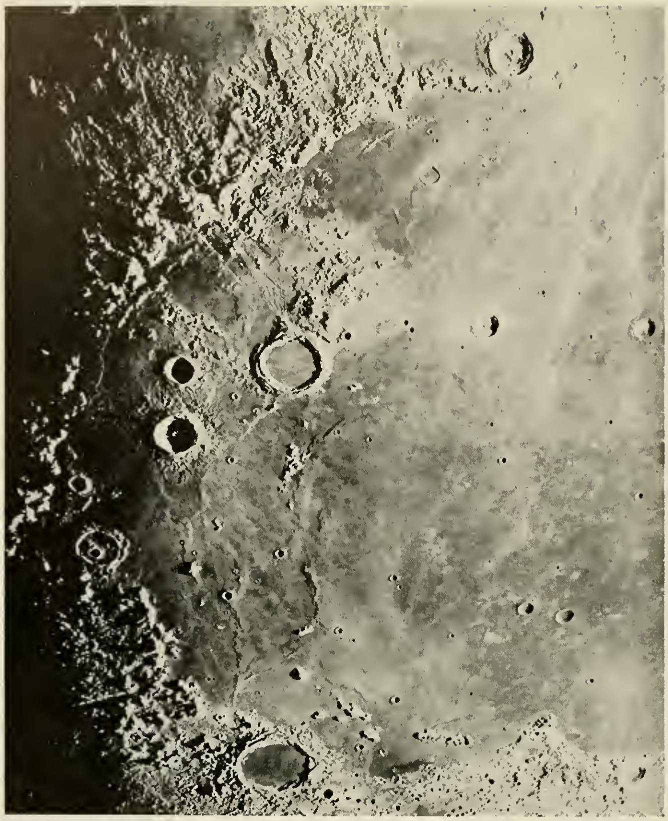
In the 1930's, lunar astronomers began to speculate on the fate of the meteorites which they knew must be striking the moon. Dr. Lincoln La Paz, then of the University of Chicago, made calculations which showed that meteorites weighing ten pounds or more, falling on the dark portion of an *airless* moon, should disintegrate in a flash brilliant enough to be seen with the naked eye from Earth. Over 100 such flashes should occur each year, and they should be seen not only by astronomers but by strolling lovers, outdoorsmen, navigators, and other well-placed observers. We know that such "lights on the moon" are not ordinarily seen; however they *have* been reported two or three times in all human history — just often enough to persuade us to be tolerant of the medieval artists who placed stars within the arms of the crescent moon.

All this was further argument for the existence of the moon's atmosphere, on the grounds that most of the moon's meteorites were being consumed in its gaseous envelope before striking the surface. Indeed, the moon seemed better protected from falling meteorites than the Earth, for, with only one-sixth the gravitational pull, the moon's atmosphere is far less concentrated toward the surface. At some elevation, estimated at between 43 and 55 miles, the atmospheres of both Earth and moon have the same density. Above that height the moon has the denser atmosphere and is thus better able to destroy meteorites at great heights.

The question remained: Might not the meteors flaring through the moon's atmosphere be visible from Earth? Calculations showed that the very brightest meteors on the moon—those that would be reported as fireballs if they occurred on Earth—should be faintly visible through telescopes.

Accordingly, in 1941 Mr. Walter Haas, Publications Editor of the Association of Lunar and Planetary Observers and one of the most experienced students of the moon, began an extended search for lunar meteors. In 170 hours of searching the dark portion of the moon, Haas and his associates detected 12 bright, moving specks which began and ended at points on the moon visible under the telescope. During these observations four or five of our own meteors crossed the telescopic field—meteors flashing in the Earth's atmosphere overhead. One or two of the lunar flashes may also have been extremely faint earthbound meteors coming almost directly toward the observer, but the laws of probability indicate that most of them occurred on the moon.

In addition, the search for lunar meteors revealed two momentary



◄ THE MOON has generally been thought to have no atmosphere, but clouds occasionally obscure parts of the great crater Plato, at the bottom of this photograph. This view of the moon at the last quarter shows the lunar Alps and Appennines in bold relief

bright points of light on the moon, which may have been true impact flares of great meteorites.

There is some possibility that these stationary flares were brief volcanic eruptions, for certainly vulcanism has played a part in the history of the moon. Early astronomers thought the vast dark areas of the moon to be seas and gave them fanciful Latin names such as Mare Serenetatis and Mare Nubium—Sea of Serenity and Sea of Clouds. Better telescopes of more recent years have shown the seas to be rock-paved areas, evidently lava flows, which in some cases breached and half obliterated nearby craters. In places, pressure ridges buckled the surface as the lava lost its fluidity and fell prey to stresses of the disturbed lunar crust.

More debatable is the origin of the 30,000 craters that have been charted on the moon. Geologists, mathematicians, and ballistics experts, as well as plain astronomers, have speculated on the forces that blasted out the craters. The trend of speculation has alternated between two theories—that the craters are volcanic or that they were created by the impact explosions of planetesimal fragments. Perhaps no one theory can account for all the craters; they range in size from pits a few hundred yards across at the limit of telescopic visibility, to huge ringed plains a hundred and fifty or more miles across, with mountainous walls often thousands of feet high.

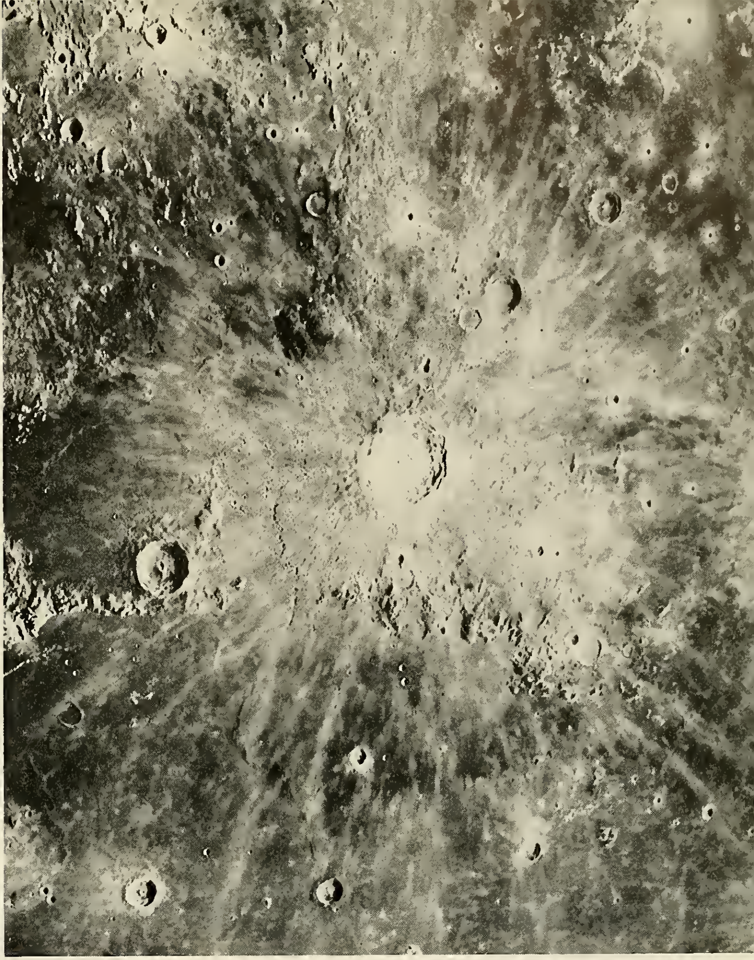
Indeed, the moon's topography is certainly more complex than the telescope reveals, for the full moon is nine times as bright as the half-moon, and this can only be explained by a highly irregular reflecting surface—perhaps a surface crowded with tiny pits. We must imagine the moon to be a place of precarious footing indeed!

Bizarre events occur in this world of jumbled terrain and tenuous atmosphere. Each month, strange dark areas known as "variable spots" spread and grow, becoming darker relative to the rest of the moon's surface as the sun climbs higher. Some of the variable spots fade again toward sunset; others continue steadily to darken until they are lost in the chill shadow of night. The size and shape of a variable spot may differ from one month to the next, and indeed some spots occasionally fail to appear at all.

The variable spots do not occur in the polar regions of the moon, and they seem to prefer protected sites, such as the depressed floors of the great lunar craters. Their behavior suggests a low but persistent form of vegetation, adjusted to fourteen-day cycles of alternate growth and rest but tolerant of great extremes of heat and cold. Should there be life on the moon, we can expect the lunar day and night thus to correspond biologically to summer and winter of an earthly year.

Faint clouds occasionally drift over the moon's surface, obscuring local details of topography. Sometimes these clouds are outlined on one edge by their own shadow. Lunar clouds are never large, and they dissipate quickly—usually within an hour or so. While the moon scarcely has spells of cloudy weather, the clouds do show preferences for certain regions, which have become famous among lunar observers. Half a dozen astronomers in the last century have seen the mist that occasionally hides details in the 3000 square-mile floor of the great crater Plato, in the far northern latitudes of the moon. Clouds in certain other craters occur much more frequently.

The surface features of the moon are variously colored, and the colors themselves are changeable. Elusive tints of green, brown, and purple, and more rarely of blue and violet, cover great areas during each lunar month, usually appearing in the same places but varying in extent and duration. Different colors may succeed one another in the same region during the lunar day. Crater floors at sunrise and sunset are usually green; under a high sun they may be green, brown, or purple.



Variable dark spots appear under a high sun in the crater Eratosthenes, the prominent one to the left of Copernicus in the center of this picture

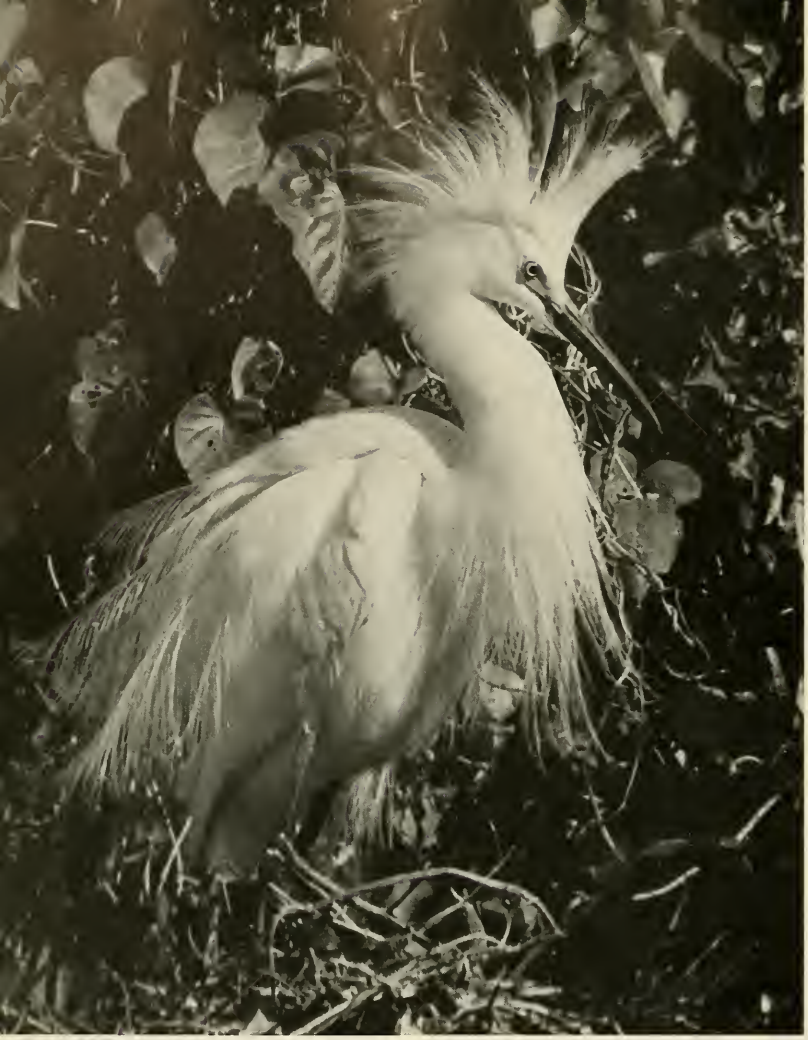
The craters and mountains themselves are subject to drastic changes. The tiny crater Linné, on the vast lava flow of Mare Serenetatis, has disappeared for months and years at a time and then reappeared with greatly altered dimensions.

Most lunar features show no changes after an eclipse of the moon, but Linné reacts violently to the sudden chill and darkness of such an event. During eclipses the surface temperature of the moon drops from around 214 degrees F. to −143 degrees, recovering quickly when sunlight returns. Linné usually emerges from the Earth's shadow with the bright area around its crater greatly enlarged. The area returns to its customary size only after an hour or more in the sunlight.

Observing the moon is not easy. Changes in the shape and brightness of a single lunar feature require the attention of an experienced observer for an entire year before his findings are credited. The neophyte has no small task merely learning the rudiments of the moon's geography, including the locations of the 600 craters prominent enough to have been individually named. Excellent seeing conditions occur in most localities only two or three times a year. An observer must be alert for favorable nights, when fuzzy spots that have strained his eyes many times before suddenly and briefly clarify into definite craterlets or pits or ridges.

More detail can be seen in any fair-sized crater of the moon than on the entire surface of the planet Mars. These details must be sketched at every observation, for the human eye is far superior to photographs in studying minute telescopic objects. Most astronomers use only one eye for their work, some preferring the right, some the left eye. Seasoned observers are convinced the preferred eye is the only one that "learns" the moon. When they look with their "off" eye the moon seems uncomfortably bright and its detail blurred.

Scarcely one astronomer in six today is on familiar terms with the moon. The great telescopes of the world are employed in the study of distant regions of the Universe, and only scattered observers—mostly amateurs—keep alive the older study of the moon. Their enthusiasm is understandable, for less than one-tenth of the moon's visible surface has been studied systematically. Any persistent observer may discover a startling event on the moon, tonight, or the next night, from his own back yard.



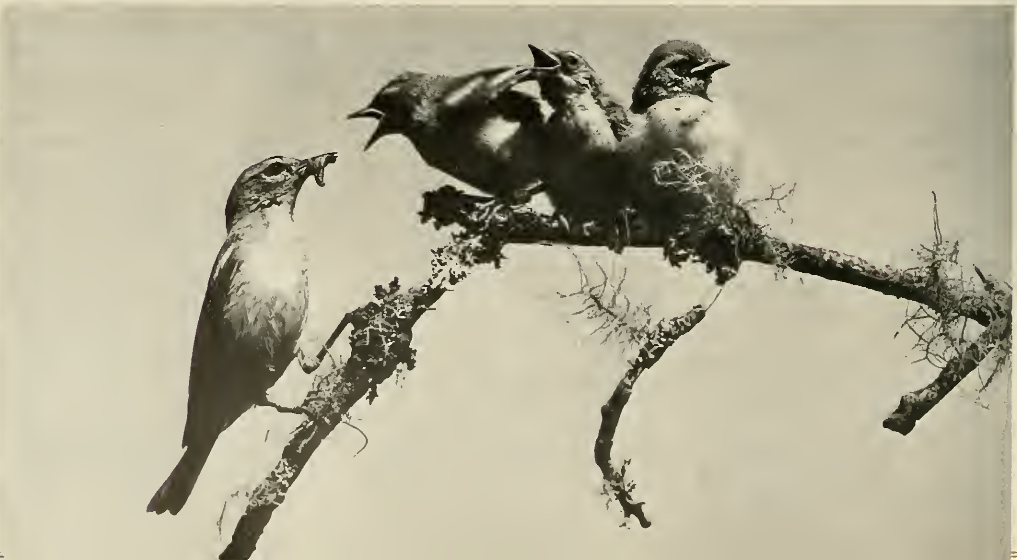
Bird

by

The exhibit from which these photographs are selected will be open to the public at the American Museum from February 8 to March 5.

< SNOWY EGRET
in the Everglades of Florida

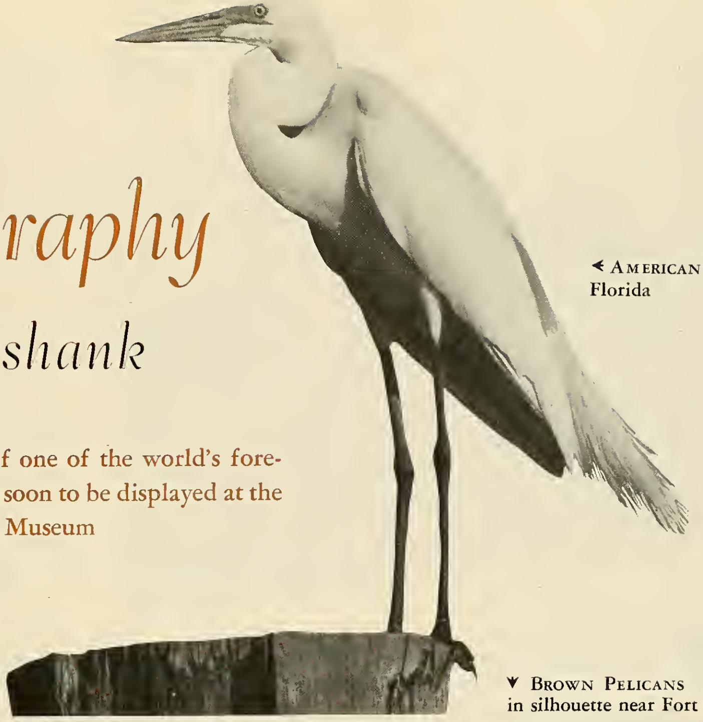
∨ PARULA WARBLERS
at Muscongus Bay, Maine



Photography

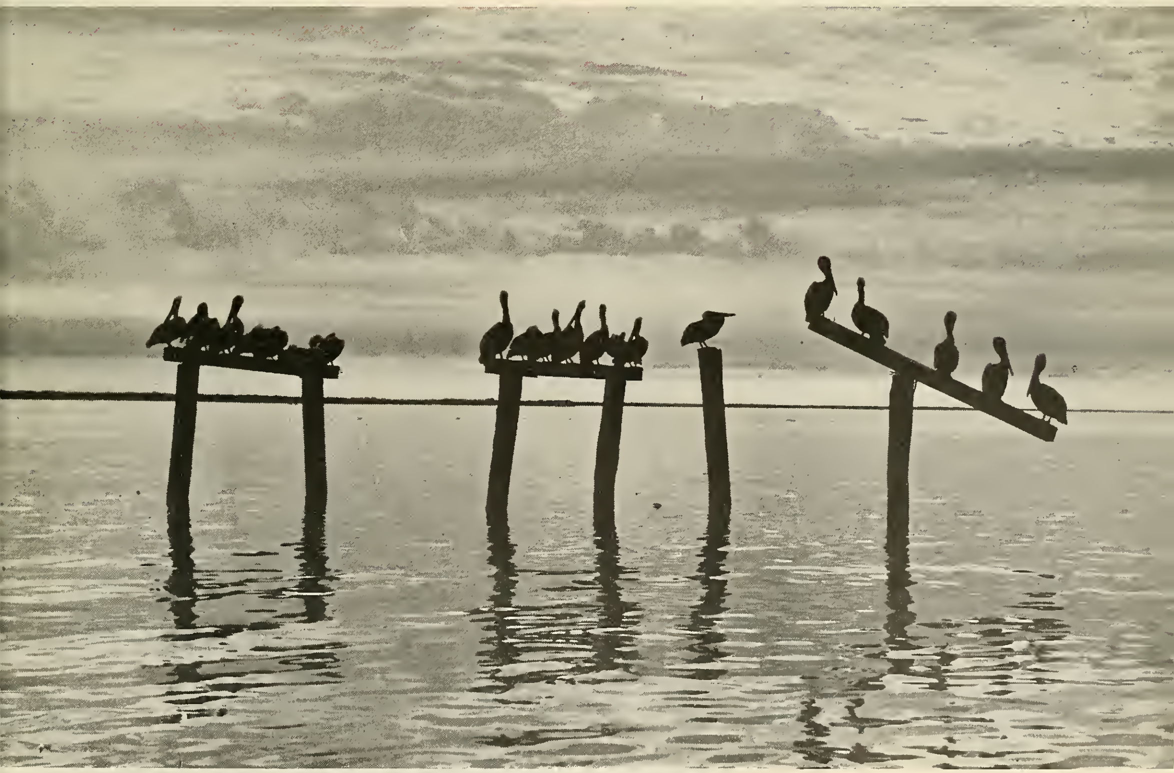
Allan Cruickshank

Selections from the work of one of the world's foremost nature photographers, soon to be displayed at the American Museum



◀ AMERICAN EGRET—
Florida

▼ BROWN PELICANS
in silhouette near Fort Pierce, Florida



Mme. Eskimo Prove

When the women of Nunivak Island suddenly found an artistic opportunity, fascinating figures ranging from centipedes to whales appeared on their baskets

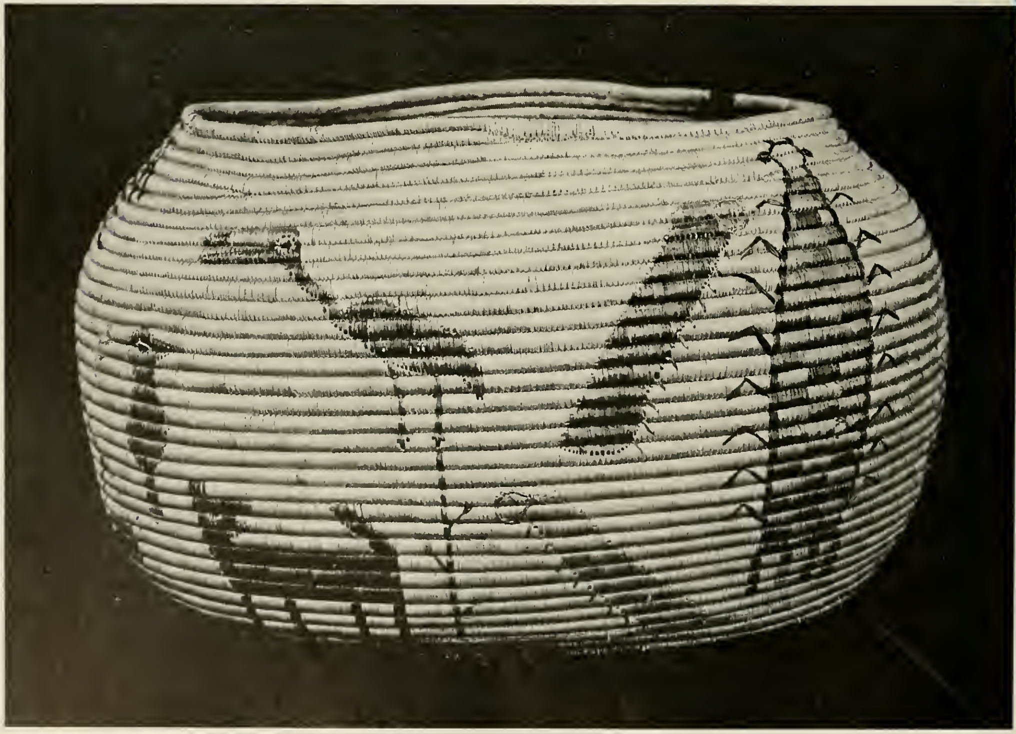
By Margaret Lantis*

Illustrations from the author's collection

ESKIMO women around the east side of Bering Sea were underprivileged, inhibited, and inexpressive right down to the 1920's —but only aesthetically, one must understand. In everyday chores they were unusually competent and independent, and they certainly were not depressed people. In art, however, they could only stand around and admire the men's creativeness. Men carved and etched dozens of things, from walrus ivory. They carved ornaments; handles for buckets and bags; snow knives for cutting and scrapping snow; points, heads, prongs, and foreshafts of long ice chisels; meat hooks and ice hooks; bird spears, fish spears, harpoons, and other implements. They made fancy tubular containers for the women's needles, and above all they carved the amulets, or charms. These were worn on the body and tied on all the hunting and fishing gear. They were carved in the likeness of worms, bears, men, birds, or almost any other creature that could hold and give one some particular power when it was needed.

The men carved wood, too, their most spectacular products being masks as much as three feet high and elaborate in proportion. The wooden dishes, buckets, cups, and spoons, from which everyone ate, were not only carved but painted with animal designs.

And what did the women make? Clothing, skin sewing kits or

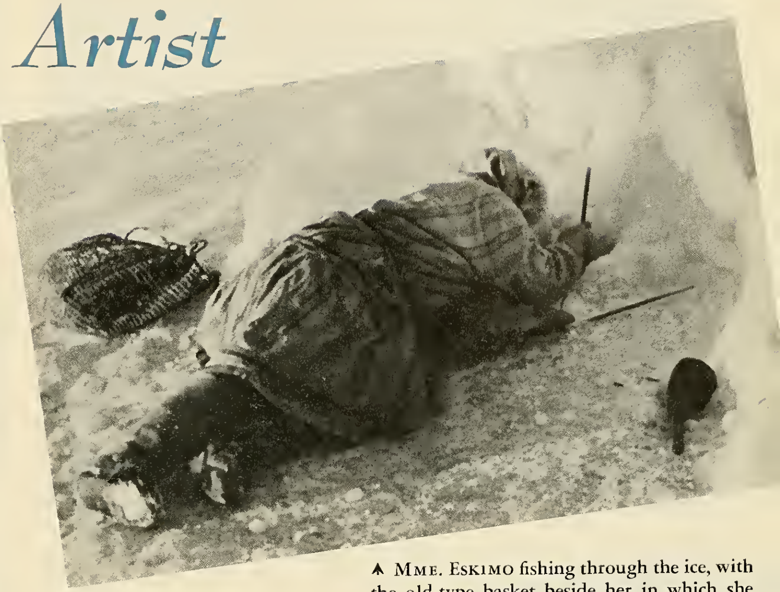


AMNH photo

▼ Birds, insects, and four-footed animals, neatly and artistically woven into the new-style coiled basketry, gave artistic expression to graphic talents originally developed only as childhood pastimes. This is an enormous basket about two feet in diameter

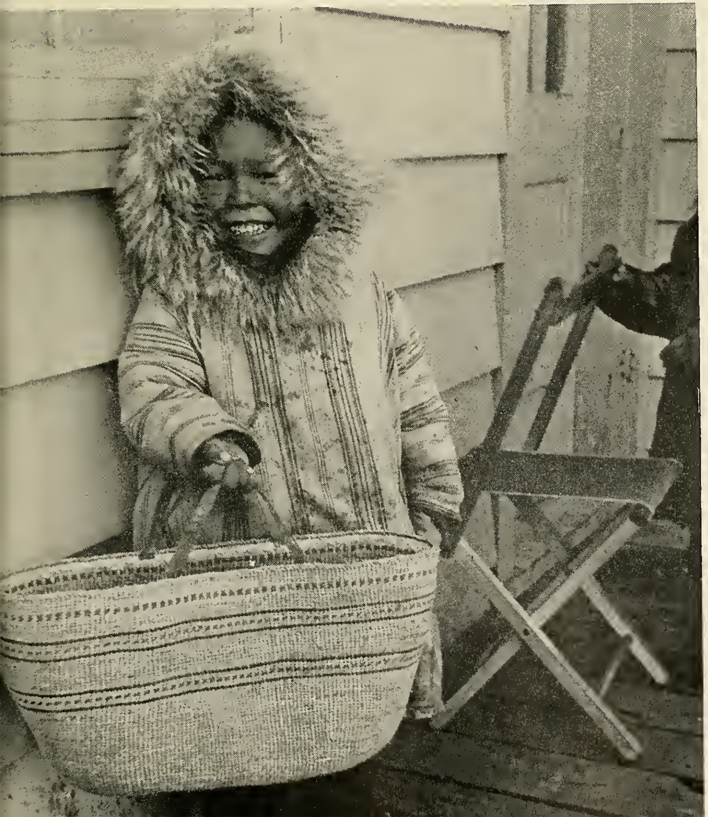
Herself an Artist

"housewives," small fur bags or pouches to hold trinkets, and occasionally an elaborate dance headdress. However, before trade brought tiny Czechoslovakian beads, American buttons and red flannel, and perhaps Canadian yarn, the clothing was very plain. Fancy borders on the garments, with designs worked in contrasting colors of "fur" (usually tanned calfskin imported from the States) are familiar today on parkas and boots but were not made in pre-Discovery times.



▲ MME. ESKIMO fishing through the ice, with the old-type basket beside her in which she will carry home the tom-cods she is spearing

▼ THE OLD-STYLE UTILITY BASKET was always made in the two-strand-twine technique



▼ FRINGED MATS, big and coarse, that cover the dried fish show the long Wild Rye (*Elymus mollis* Trin.) from which most baskets are made

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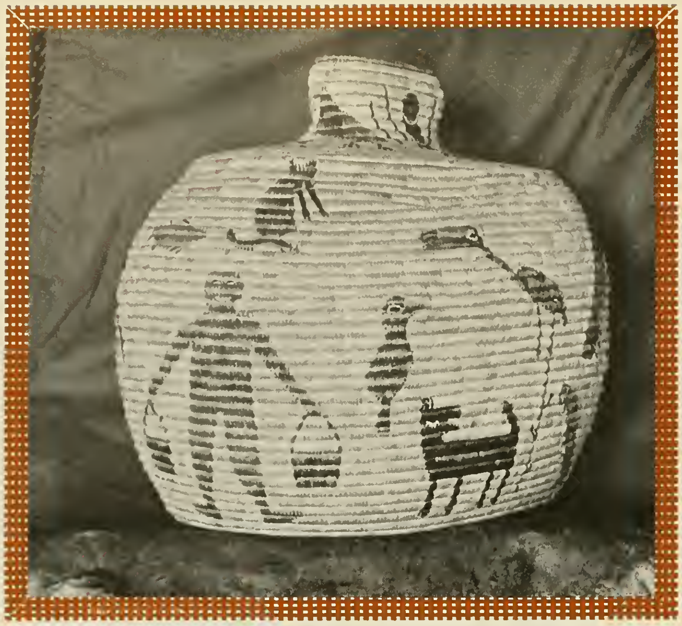
[*] MARGARET LANTIS is the author of several important works on the Eskimos and has made two visits to Nunivak Island, including a year in 1939-40 and three months in 1946. Readers will remember her previous article in NATURAL HISTORY for October, 1941: "No Wonder They Worship the Seal."—ED.



▲ **Almost any figure** common to daily experience may be worked into the modern coiled basketry of Nunivak. Naturalistic designs like these were formerly the special privilege of the men

AMNH photo

▲ **Another example** of old-style weaving: grass socks from Nunivak, representing the era when the women concentrated on clothing and the men had a corner on the graphic arts

The women had to be content with admiration for their finely stitched seams.

Women did prepare and stitch the skin covers on the kayaks, but men painted the totemic designs on them. Women made skin water-bottles, but men carved neckpieces and stoppers for them. A woman would skin the animal to provide the head for a drum, but her husband or son painted it with the figures of animals commemorating great deeds in hunting.

In one craft, though, the men had no part: basketry. Women made fine mats to cover the inner walls of the house and the sleeping platforms; large coarse mats (that were mostly fringe) to keep flies off drying fish and meat; and a more open-weave but nicely made mat to cover the floor of the kayak. They made carrying-baskets of various sizes and fineness, and small trinket-baskets. As the highest achievement of their weaving, they made grass socks and mittens, to be worn inside the fur ones. These were all done in the two-strand-twine technique. Decoration, however, was simple and severe enough to satisfy the most austere modernist in interior decoration. No mythical creatures, with one side of the face looking like a fox and the other side like a man. No figures of seals twisting to escape killer whale or harpoon. Such realistic art was for the men.

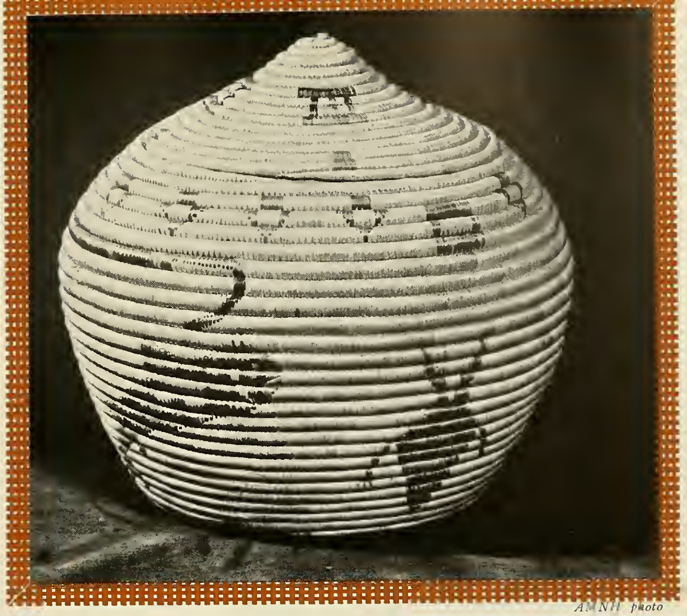
Then, soon after 1920, a trader taught some Nunivak Island women to make baskets in an entirely different technique: by coiling spirally a bundle of fibers and then stitching them one coil on top of the other, instead of weaving them by the twined technique. Women on the neighboring mainland had already learned the coil technique, with mixed and not especially noteworthy results. To the Nunivak Island women, however, here was a new medium of personal expression, and they did not waste the opportunity.

By the 1930's, not only were such familiar objects as dog teams figured on the new basketry; much less obvious and seldom mentioned things like crabs and flies appeared crawling up the sides of the meticulously made baskets. Here are some of the creations, artistic or not: a man carrying a fish in each hand, a crane with a fish in its mouth, cormorants sitting on the water, a mythical spirit with his mouth located on his chest, a Christmas tree (of which there are none on the Island), a red fox sitting on its haunches, a beautifully mobile fish about to be speared with a three-pronged fish spear, not to mention the bees and the buttercups. The attentive, accurate observation for which Eskimos are famous was illustrated again in this new medium.

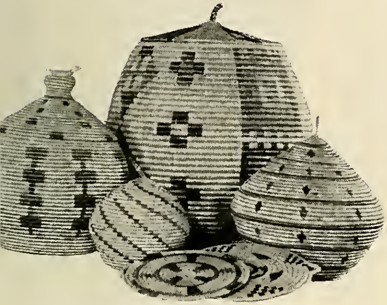
From the alacrity, creativeness, and skill with which the Nunivak women developed and elaborated the new basketry, one might wonder how the naturalistic art of Eskimo culture could have lain latent in the women's minds for so many generations. The answer is that it was much more than latent. It had long found expression in other ways during the formative years of feminine life.

The kind of snow knife that was used in the central Arctic to cut blocks for the snowhouse was used here, where snowhouses were not built, in a fascinating game played by little girls. Father or grand-

➤ Strangely enough, the baskets bearing naturalistic designs like this one do not attract the tourist trade as much as the type shown below


AMNH photo

▼ Simple geometric designs like these appeal to the outsider, though their cultural significance is not so great

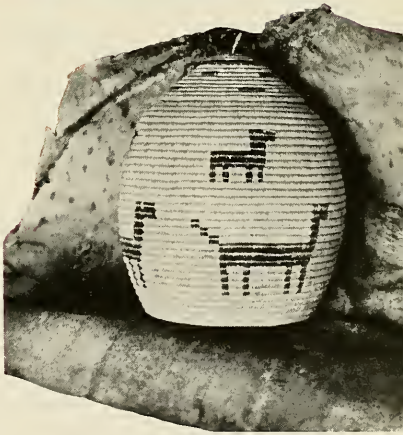


father would carve out the ivory knife and probably etch pretty designs on it. This was the most artistic plaything possessed by a girl. In playing the game, a girl anywhere from five to ten years old would draw, in sand smoothed by the retreating tide or on untrampled snow, as realistic a picture as she could make. If the snow knife was not at hand, she might draw with her forefinger. She would perhaps picture a house with two children inside, a birdskin parka, a dog with puppies lying beside the house, an old grandmother leaning on a cane. The object of the game was to make other girls guess what specific household, people, or activities the little artist was interpreting. In this example, she had in mind the house of Favorite Daughter, who had two young children and who was busy at this time making a new parka. News items that might not be known to all the children would make the guessing more fun—the fact that the lead dog had recently produced puppies or that granny had just hobbled over for a visit.

The more exact the portrayal, the easier for one's opponent to guess. So one might wonder that the children should not strive for realism in their sketching. In the old days, though, good workmanship was valued highly by the Eskimos in most of their crafts, and good observation was enjoined in everything, even in childhood games. Hence one played to the best of one's ability, just as today the woman carefully delineates a flying bird when she uses imported colored raffia instead of a snow knife in the sand.

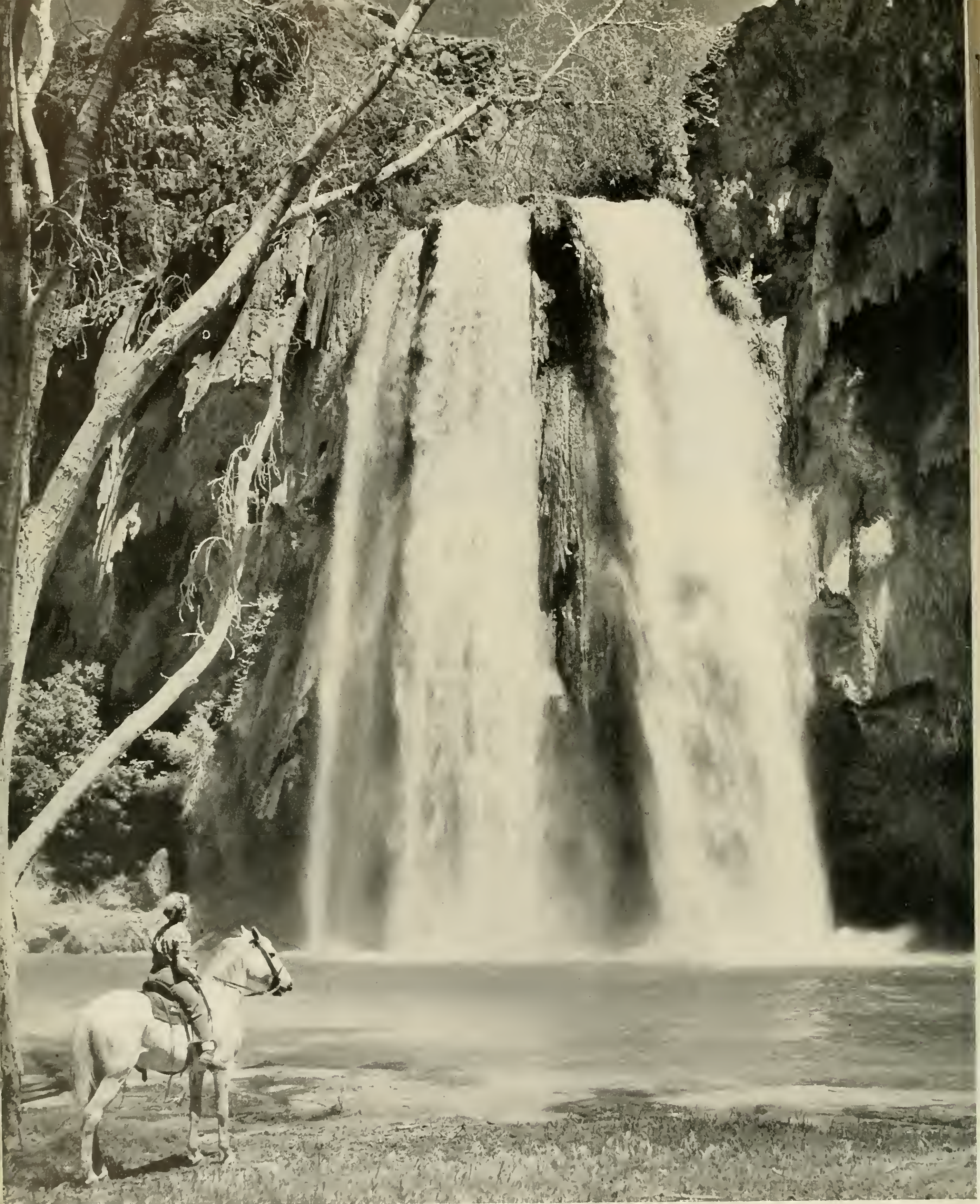
Unfortunately, in the 1940's buyers in the States and even tourists in Alaska looked with consternation at the miscellaneous plants and animals sometimes slapped helter-skelter on the sides and tops of the baskets, and bought the more sedate ones with geometric designs. These have been made from the beginning, along with naturalistic designs, and have at last largely triumphed, although they have virtually no meaning in Eskimo culture.

One might wonder whether, as a compensation, the women would not try to adapt the new naturalistic motifs to the old woven style of basket. Apparently there is not a single instance of this. Even the realistic and adaptable Eskimos have their conservative areas of



▲ Except for details of eye, whisker, or feeler, which are added later, all the figures are stitched on the baskets at the same time as the wrapping of the coils

behavior. The twined basketry looks as it did 50 years ago, unless in the past few months some creative genius has made this combination of old and new. There are always surprises though, as when one first encounters a basket nicely decorated with worms. Eskimo women undoubtedly will find, in time, new ways of demonstrating that they are just as observant natural historians as their menfolk.



Josef Muench photo

▲ HAVASU FALLS: one of the entrancing spots in the desert paradise of the Havasupai Indians. Note the travertine festoons deposited by spray from the sky-blue falls

CANYON Utopia

It is like discovering a Shangri-La right in the United States to visit the Havasupai Indians, who long ago found an idyllic life in a hidden canyon in Arizona

By PHILIP FERRY

THE Supai Indians of Havasu Canyon in northern Arizona have the nearest approach to Paradise to be found on the North American continent. They live in a region of undisturbed wilderness and unsurpassed scenic grandeur. They are wards of the government, and they have no temptations to speak of, since the settlement supports no trading post to dispense those outward manifestations of civilization that might tend to disrupt the fine balance of their tranquil existence. Their tiny post office is perhaps the only one in the country served by pack animal, the mail being brought in over fourteen miles of wild trail from Grand Canyon.

When that brown-robed explorer, Padre Francisco Garces, wandered by chance into the canyon in June of 1776, he found living in that hidden corner of the desert world a tribe of Indians that had never seen a white man. Their legends did not reveal how long they had been hidden in this unexplored tributary of the Grand Canyon of the Colorado. They were the most isolated tribe the Spaniards had encountered in all their wanderings over the great sprawling Southwest.

After Father Garces' visit, we do not hear of the Havasupai again until their canyon was rediscovered by a railroad survey party in 1858. Until early in the present century, there was no regular intercourse with the white man. Then in 1911 a disastrous flood occurred, which prompted the United States Government to send aid and paved the way for a closer contact with the outside world.

Havasu, or Cataract, Canyon, in which Havasupai village is located, is part of the Grand Canyon system, which winds and twists through 100 miles of mesa country amid a veritable maze of smaller but equally enchanting canyons. Some 50 miles west of the settlement known as Grand Canyon, one finds himself in a wildly romantic region in the heart of which lives this interesting tribe of Indians. The Indians call their canyon Havasu, or Canyon of the Blue Water—a highly appropriate name, since the water of the creek is of a sapphire brilliance. The Indians themselves are the Ha-ha-va-

James H. Barbour photo

▲ THE HAVASUPAI INDIANS are friendly and cheerful. They were discovered in 1776 but had little contact with the white man until the present century

James H. Barbour photo

➤ DESCENT into the hidden canyon is by a steep trail from Hilltop, Arizona, on ponies provided by the Indians su-pai "The people (*pai*) of the blue (*va-su*) water (*ha*)." This has been compressed until the people have become the Havasupai, or Supai.

To reach Havasu Canyon we turned off U. S. Highway No. 66 near Peach Springs, Arizona, and drove 60 miles across the northern Arizona plateau to a jumping-off place called Hilltop. From this point, a steep trail leads down the red sandstone wall to the village in the canyon below. Over this trail mules carry the few items of food and clothing brought in from the outside world by the fortunate inhabitants of this canyon utopia.

Having motored into Peach Springs, we contacted a representative of the Indian Service, who radioed the agent at Havasu of our coming. By the time we drove the 60 miles from Peach Springs to Hilltop, the Indian riders were coming up the trail to meet us. Riding the familiar small-framed Indian ponies and herding along the pack animal that was to carry our gear, they made a picturesque procession, with the riders silhouetted against the high Red Wall, chanting some ancient tune to speed the animals along. At Hilltop, they tended first to the needs of the animals, then squatted around a small campfire and prepared a substantial meal of barbecued beef, black coffee, and bread.

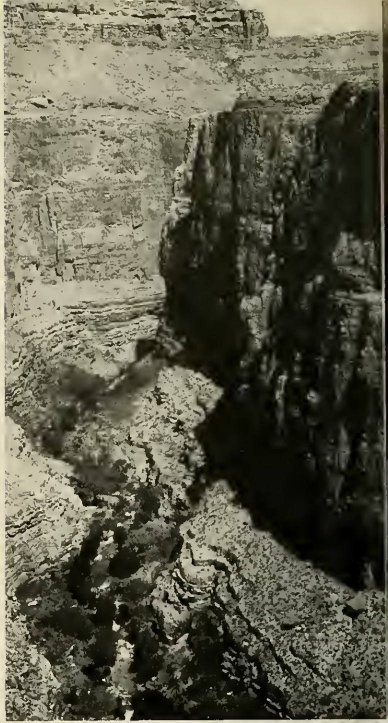
When the meal was over and they had loaded our gear, we mounted and started down the trail. The trail zigzags down the face of the cliff, then runs for nine miles along the floor of Hualpai Canyon, a tributary of Havasu. It is a dramatically picturesque trail, with red sandstone walls towering overhead. At the junction of Hualpai and Havasu canyons, we caught our first glimpse of the village in its enchanted canyon setting.

The little valley in which the Supai live is merely a wide place in the canyon. On both sides rise perpendicular reddish sandstone pillars, which are known as the Supai Gods. Legend says that when these revered pillars fall, the Supai will disappear from the earth. Through the center of the valley runs the tree-lined creek, flanked by cultivated fields and the wooden cabins of the natives.

Nature has endowed the Havasupai with a healthful climate, a bounteous water supply, fertile soil that is easy to cultivate, and a degree of seclusion that immediately conjures

Gladys V. Broderson photo

▲ THE "SUPAI GODS" look down upon the valley from each side. When they tumble from the sky line, legend says the Supai Indians will disappear from earth



James H. Barbour photo

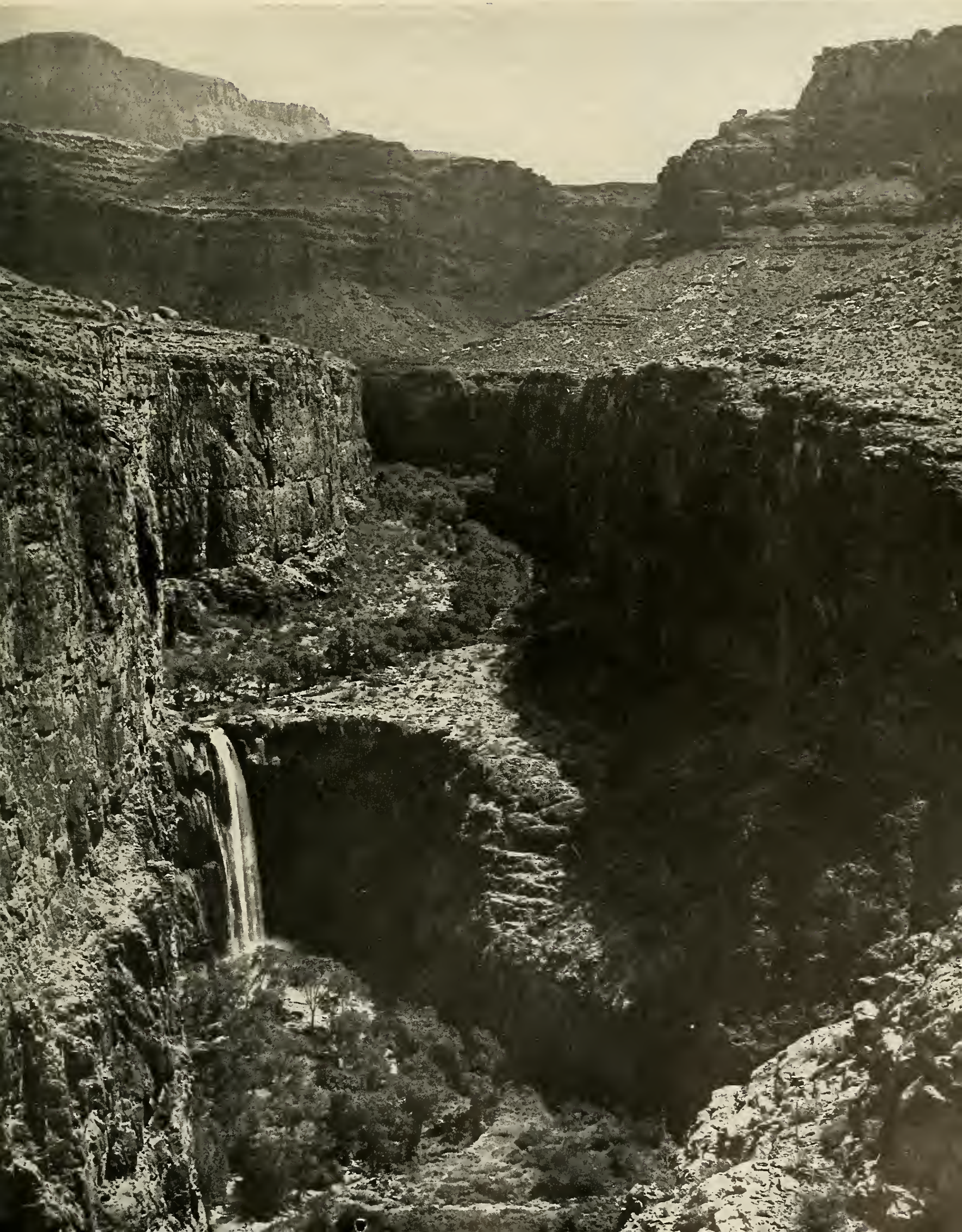
Gladys V. Broderson photo

➤ A VIEW of the cultivated fields and cottonwood trees from Apache Trail. At this point, the Havasupai are said to have attempted to halt raiding Apaches

◂ **From the rim**, this tortuous tributary of the Grand Canyon appears a forbidding homeland even for a hardy tribe of Indians

▾ **But when** one spies Mooney Falls and its pool of turquoise water, one gets a taste of the entrancing beauty that lies farther upstream, where the village is located

Alfred Schmitz photo



James H. Barbour photo

▲ A HAND CABLE assists the climber in scaling the cliff near Mooney Falls and in exploring the travertine canopies and caves

up visions of Shangri-La. In addition to these practical assets, Havasu Canyon has a scenic grandeur unexcelled in any section of the Grand Canyon country. Crowning all is the series of enchanting waterfalls and cascades that have given the valley its optional name of Cataract Canyon.

The passage of a century and a half finds approximately the same number of people living in the canyon and tilling the same red soil as in Padre Garces' day. The only outward evidences of exposure to the culture of the whites is in their colorful garments and their wooden cabins, which in recent years have replaced the aboriginal brush-thatched huts and log houses. These homes were provided by the United States Government and are not a gift to the Indians. They were built with the understanding that the debt would be repaid at the Indians' convenience, either in the form of cash or "compensatory labor"—work in the National Park, on the roads and trails, etc. While many of the ancient structures remain, they serve as storehouses, granaries, woodsheds, etc. They are not occupied by the Indians.

Since 1910, the population has fluctuated between 170 and 250. At the present time it is 220. The birth and death rates manage to balance each other rather closely, although an occasional epidemic of measles, dysentery, or pneumonia takes its toll. With this small population, some degree of intermarriage is inevitable, although the Supai claim never to marry closer than first cousins. Of late years the men have taken to going outside to pick brides from other tribes, such as the Hualpais and Navajos, though the latter were at one time their deadly enemies.

The grand lama of this desert Shangri-La is the white school teacher assigned to the village by the Indian Service. This agent, whose official title is Principal-teacher in charge of Havasupai Subagency, is teacher, counselor, and friend.

The agent takes his responsibilities seriously and watches over his wards with the single-mindedness of one whose appointed mission is the saving of these people from unwise exploitation. The Havasupai are a simple people, peaceable and submissive. With the Apaches and Navajos raging savagely over the Southwest in centuries past, the docile Havasupai might well have been exterminated had they not found a secret haven in Havasu Canyon. Luckily, the site provided not only a sanctuary from their enemies but a veritable Garden of Eden as well.

Despite the small number of inhabitants, the canyon is overpopulated for its limited resources, and the Indian Service has under advisement a plan that would make the Supai self-supporting without the danger of disturbing the fine balance of their simple existence.

"We are endeavoring to divert national attention away from the people of Havasu and focus it on the beauties of the canyon," Subagent Guthrie told me, "so that future visitors will come to look at the scenery and not to gape at the inhabitants. Altogether too much emphasis has been placed on the people of Havasu Canyon and too little on the canyon itself. Ethnologists say the Havasupai differ little from the Indians who dwell on the plateau above. In fact, they speak essentially the same language—a dialect of the Yuman tongue. However, in the centuries of their isolation they have developed a manner of life that might be the envy of other tribes.

"The scenic attractions of the canyon, including the picturesque trails, the superb waterfalls, and the dramatic walls, are of a nature to draw visitors from every part of the country. A plan has been submitted to the Indian Service proposing the inauguration of a three-day, all-expense guided tour of the canyon region and the waterfalls. The rate would include use of saddle pony, pack animal, dormitory accommodations, and meals."

There are four beautiful falls in Havasu Canyon named, successively, Navajo, Havasu, Mooney, and Beaver—Mooney being named for a prospector who fell to his death over the falls some years ago. In addition to their great beauty, the falls make the canyon a working laboratory for one of nature's most interesting phenomena. The waters of Havasu Creek are highly impregnated with lime, and as the water evaporates it leaves behind a minute film of lime which attaches itself to everything it touches. When solidified, this material is known as travertine. The deposition accumulates in three interesting forms. The first takes place at the waterfalls. In tumbling over the canyon walls, the water releases clouds of lime-impregnated spray, which dash out on all sides. When the water in the spray evaporates, a minute film of calcium is left on the surrounding canyon walls, on rocks and soil, on trees, twigs, branches, and stumps. Everything the spray touches begins immediately to take on an outer layer of stone.

Strangely enough, these calcium deposits do not necessarily kill quickly. The deposition is so slow that the process may go on for years before bringing about the death of the tree. However, since the stream flows the year round, the process goes on endlessly. One of the most interesting phases in this process of accretion is the encrustation of logs and sticks. A dead trunk or a piece of wood may in time become completely surrounded by a shell of travertine, anywhere from an inch to twelve inches in thickness. When the inclosed wood eventually rots away, it leaves behind a cylindrical rock shell in the identical shape of the encased object.

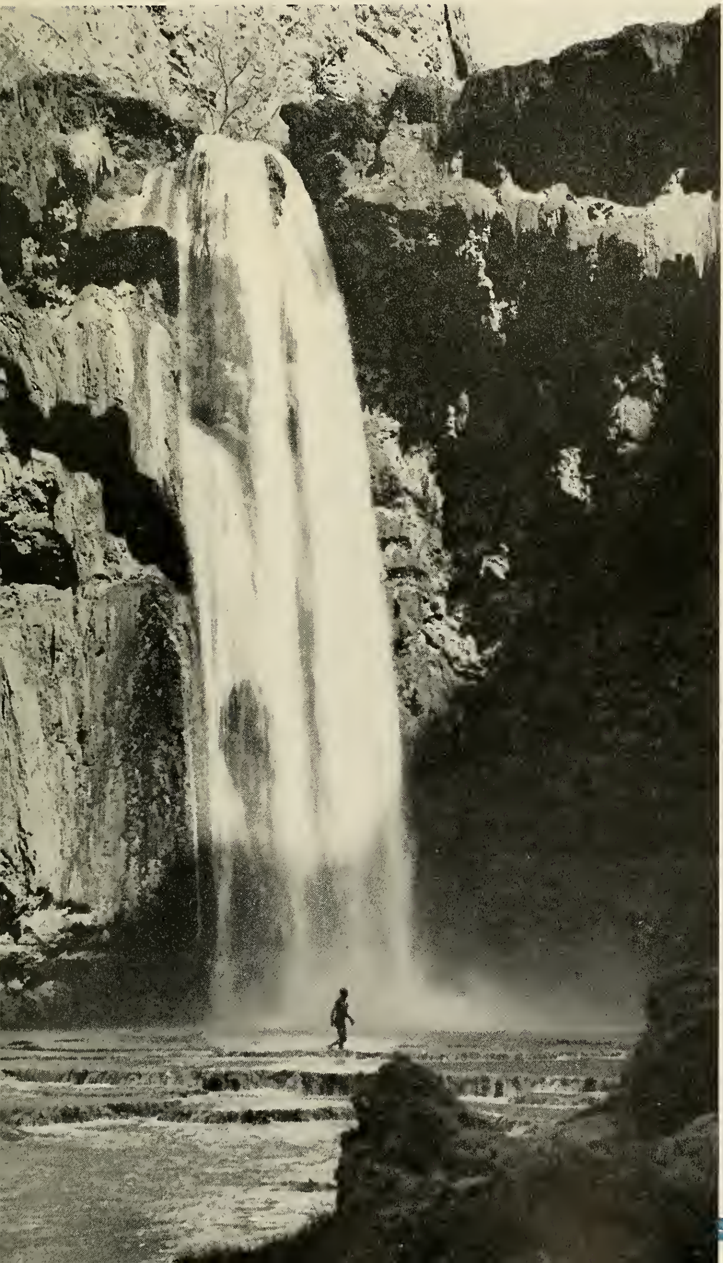
A second type of accretion is that in which the creek water builds low limestone dams across the stream. At the base of each waterfall is a series of these low terraces. To step into one of the pools is to stir up whirlpools of the milky calcium deposited on the stream bottom. The runoff channel of each fall is usually a snow-white, calcium-lined trough through which flows a jewel-like turquoise stream. It is this turquoise hue that has prompted the Indians to refer to themselves as the "People of the Blue Water."

A striking feature of this process of calcification is that, unlike true petrification such as we see in the Petrified Forest, Yellowstone Park, and elsewhere, the deposition in Havasu Creek is not a prehistoric occurrence. It is a living, working procedure going on daily. Here can be seen one of the natural wonders of the world taking form before one's very eyes.

The visitor is not always aware at first glance of the extent of the calcification that has already taken place in the canyon. Great "boulders" that have broken away from prehistoric terraces and hillsides often prove to be masses of calcified material — stone, soil, logs, and branches — solidified into one body and held together by the cementing action of the lime. Between Navajo and Havasu falls is a broad plateau over which the main canyon trail passes. On investigation, this mesa proves to be a massive heap of cemented rubble, riddled with logs and other debris, and situated on the opposite side of the canyon from the present-day stream. Mooney Falls, the most beautiful of the quartette, is set in an amphitheater where the surrounding travertine walls are so honeycombed with detritus that the Park Service, foregoing the usual practice of building a foot trail down the face of the cliff, has dug an approach down through the interior of the soft travertine walls, forming a series of galleries through which a trail descends to the base of the fall.

Here at Mooney Falls is found the most striking example of the third type of accretion. In this instance, the sidewalls surrounding the falls are festooned with hanging stone

James H. Barbour photo



◀ Mooney Falls, showing the travertine terraces in the pool at its foot

Gladys V. Broderson photo

James H. Barbour photo

◄ A COOL SPOT for a rest, amid the roar and spray of Havasu Falls

▲ HAVASUPAI JUNIOR MISSES, who can't understand why visitors from the outside world are so curious

draperies and filagree work, which are as delicate as if created by a skilled seamstress. These travertine festoons, formed by the lime-impregnated spray from the falls, have the appearance of cascading water that has been instantly solidified into the graceful, curving lines assumed by falling spray. Like a prehistoric stream that has left its imprint in an ancient fossil bed, the travertine seems to have captured likenesses of the waterfalls and printed them indelibly on the walls. In some instances, an entire amphitheater is festooned with an overlapping series of these stone canopies which, like the multiple folds of a ballet skirt, give the effect of water fluttering lightly down the face of the cliff.

At Havasu Falls the deposits have accumulated to such an extent that they have formed a stone hood extending fifteen feet from the wall. This hood acts like a giant umbrella, deflecting the water outward from the wall and causing it to tumble down the face of the cliff without wetting the wall behind. Since the stream has shifted its course several times over the centuries, many of these stone canopies are far removed from the present-day stream.

In one respect, the falls in Havasu Canyon are the reverse of ordinary falls, for they are building up where other falls are wearing down. The waters of Havasu Creek build a calcium "lip" at the edge of each fall. This lip grows higher with time until ultimately a barrier is formed, cutting off the flow of the water. The stream is thus forced to seek a new channel. This action has been going on for ages, and as a result each of the existing walls is surrounded with the evidences of old abandoned channels, with the present-day stream tumbling over only a small portion of the enclosing amphitheater.

Instead of climbing up to visit these falls, one views them first from above and then travels downhill to reach them. The northern end of Cataract Canyon is a double gorge, like the Grand Canyon. The first gorge is a mile wide and a half mile deep and cleaves through the white limestone formation. The second gorge is narrower and only 300 to 500 feet deep and winds through the

James H. Barbour photo

◄ A SWINGING BRIDGE spanning Havasu Creek affords a good view of some of the limestone terraces red sandstone strata in the bottom. To the northward, the canyon drops away by the series of falls to join the Colorado River and the Grand Canyon. The Indian village is shut in on all sides by towering cliffs, which can only be scaled in one or two places. The village is situated at a high point in the valley. Before issuing as a spring in the canyon wall, the stream passes through several layers of limestone, where it dissolves and picks up the accumulations of lime that are carried downstream to the falls, where they are precipitated in the form of travertine. So heavy is the lime deposit in the region that one of the large side canyons is appropriately named Carbonate Canyon.

The process of accretion taking place in Havasu Canyon is in general comparable to that which forms the stalactites in Carlsbad Caverns. It is also similar to the process of accretion that takes place about the geysers and hot pools of Yellowstone. There, however, colonies of microorganisms, particularly algae, flourish in the more temperate waters, causing the precipitation of calcium carbonate. In Havasu Canyon, the precipitation is clearly the result of evaporation.

The Havasupai have always been farmers. The main valley is extensively cultivated, and each family has its own plot of ground. In recent years the Indian Service has improved the ancient irrigation system, laid out by the ancestors of the present people, by tapping the stream above the village and installing a canal that serves to irrigate the patches of squashes, beans, and corn—all typical Indian staples—and some melons and ancient peach trees. The latter are said to have been brought into the canyon by an early Mormon fugitive who sought refuge there after the Mountain Meadows Massacre. Much of the tillable land yields Bermuda grass and alfalfa, valuable for the ponies every Indian owns.

The Havasupai's pride in the ownership of horses poses a problem for the Indian Service. The Indians still reckon their wealth in stock, and a family that will be pinched for till-

Continued on page 92

▼ AS IT PLUNGES over Navajo Falls, the stream makes music that is unexpected in a desert, and the damp fragrance of greenery urges the parched traveler to linger in the canyon utopia of the Havasupai

Josef Muench photo

SNAIL INVADERS

Smithsonian photo

Already entrenched and Americanized, this "Fifth Column" of alien mollusks, many of which can carry deadly parasitic diseases, is sounding a clear alert to scientists, farmers, and quarantine officials

By R. Tucker Abbott
Division of Mollusks, United States National Museum

ONE summer day in 1898, many residents of Chicago turned on their kitchen faucets for a cool drink and were startled when out popped hundreds of pea-sized snails. At the city pumping station, millions of these fresh-water snails clogged the wells and screens, and periodically they had to be shoveled out and carted away by the wagon load. Chicago's experience was duplicated in Erie, Pennsylvania, a few years later. Oddly enough, the "faucet snails" were new to most American naturalists, for their known native habitat was, until the late 1870's, limited to northern Europe.

The history of this and similar invasions of the United States by foreign snails warns us of how rapidly an introduced species can spread. In June, 1879, a snail enthusiast by the name of Beauchamp was overjoyed with the discovery at Oswego, New York, of what he first thought was a new species. Further study showed that it was this European snail *Bulimus tentaculatus* Linné, a relative of the one that carries the oriental liver fluke of humans. The initial landing spot will probably never be known, but it was possibly somewhere along the St. Lawrence River in northern New York State. Within 10 years it had mastered the barge canals from Albany to Buffalo, a distance of 300 miles. By 1888, nine years after its American landing, it had broken out into Lake Erie and established itself at Ashtabula, Ohio. From its lake beachheads it moved inland a year later to Sandusky, Ohio, and into the marshes of Toledo, Ohio, by 1911. About 1891, it had extended its range westward into Lake Michigan, striking Black Lake, Holland, Michigan, in 1891, where it was reported as "spreading rapidly." It had reached the Lake View waterworks at Chicago in full force by August, 1898.

In the meanwhile, consolidation was being accomplished in Erie, Pennsylvania, where older residents may still remember the episode of the "faucet snails." A pincer movement was initiated against New England in 1890 with the invasion of Burlington, Vermont. The snails were in the Thousand Islands by 1911, in Cornwall and Toronto, Ontario, in 1913, and in Washington, D. C., by 1927.

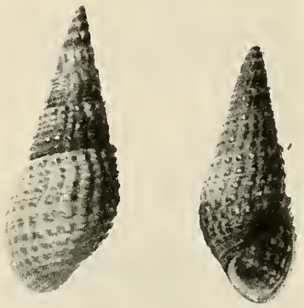
Within the last 100 years, approximately 45 immigration visas have been issued by nature to molluscan aliens. A third of these we would like to deport as undesirables. Our greatest concern is not with the foreign slugs and garden snails, though they have cost us millions in crop damage and control measures. It is not even with the threat of the ravenous giant

African snail, which has been recently knocking at our doors at both Atlantic and Pacific coast ports.* Our guard is up for the potential entry of oriental fresh-water snails that carry deadly parasitic diseases of man.

One of the most recent and successful invasions has been made by a small aquatic snail that is capable of carrying the human lung fluke, a parasitic worm of the Orient. Until recently, this so-called Thiarid snail, *Thiara granifera* Lamarck, was limited to the Far East and the western Pacific Islands. Today, it literally paves the sandy bottom of Lithia Spring, Florida, and may be found crawling happily about many a home aquarium throughout the country.

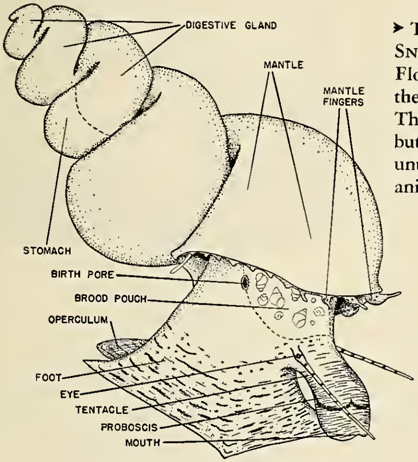
Technically known as paragonimiasis, the disease that may be carried by the Thiarid snail is not to be treated lightly. When the adult worms are attacking the lungs, the symptoms are not unlike tuberculosis or broncho-pneumonia. The disease is insidious at its onset and chronic in its course, with chills, fevers, chest pains, persistent cough, and bloody sputum. When working on the brain, the fluke is responsible for symptoms that have been mistaken for infantile paralysis or meningitis.

Nature was in one of her experimental moods when she evolved this parasite and dictated the complexities of its life cycle. The plump adult worm is about half an inch long and customarily lives encased in pockets of the lungs. The eggs of this lung fluke are coughed up and, upon reaching fresh water, hatch into microscopic, ciliated organisms called miracidia. These tiny swimmers are attracted for some unknown reason to Thiarid snails, into whose flesh they penetrate. Several weeks are spent in the snail, during which time a process of multiplying and developing goes on, which results in the production of another type of tiny swimmer, the cercaria. These must seek out and enter certain species of fresh-water crabs or crayfish in order to continue their life cycle. Within the flesh of the crabs, the larval flukes roll up into pearly-white cysts and await the day when some hapless person or animal eats the crab raw. Once inside the stomach of the mammalian host, the organism is certain to develop to adulthood and migrate to the lung.

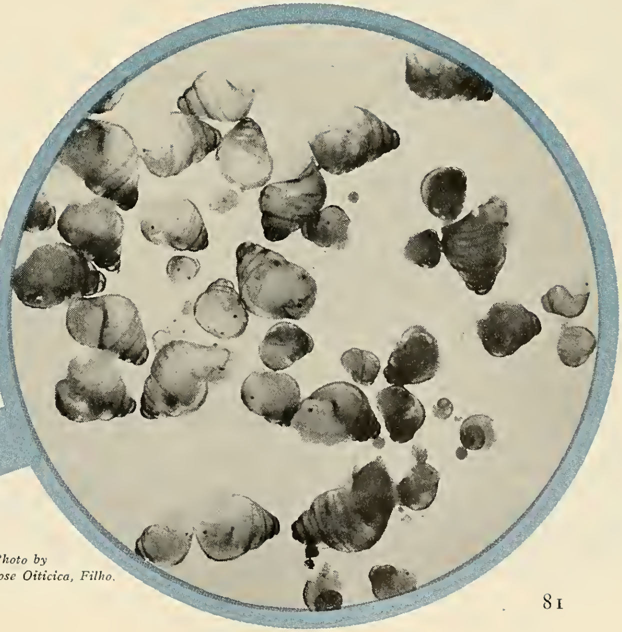


➤ The half-inch long Thiara Snails recently introduced into Florida are potential carriers of the human lung-fluke disease. They resemble our local species but may be recognized by the unusual characteristics of the animal, depicted at left

Smithsonian photo



▲ The animal of the Thiara Snail, with its shell removed to show the peculiar mantle fingers and brood pouch for the young



➤ Contents of a Thiara brood pouch, showing development from eggs to young snails about to emerge. Note the tiny eyes

Photo by Jose Oiticica, Filho.

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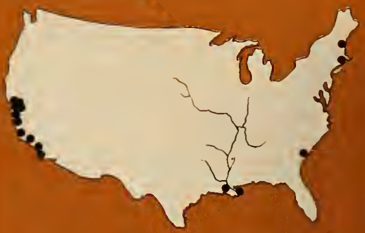
* See "March of the Giant African Snail," Natural History for February, 1949, p. 68.

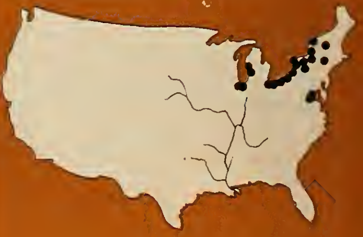
FRENCH EDIBLE SNAIL (*Helix aspersa* Müller)

THIS "ESCARGOT" or Brown Garden Snail has become a serious garden pest in California since its first introduction in 1856. These snails are still imported from France and Italy to eastern cities, where they are eaten by many people. Color: light yellowish-brown with dark brown bands and specklings. Size of shell: 1 to 1½ inches. Original home: Western Europe.



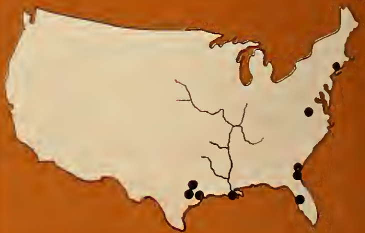
FAUCET SNAIL (*Bulimus tentaculatus* Linné)

SEVENTY YEARS AGO this small fresh-water snail made its American debut. Within a few years it spread over much of the northeastern section of the United States. It is not a human disease carrier but has been responsible for clogging the waterworks of several cities. Color: drab greenish-brown to dark tan. Size of shell: ¼ inch. Original home: Northern Europe



SPANISH EDIBLE SNAIL (*Otala lactea* Müller)

THIS LAND SNAIL is frequently imported from North Africa and Spain for food purposes. It has escaped and established itself in several places in southeastern United States, but it is not a very destructive species. Color: whitish with brown bands and gray specklings. Lip: black-brown. Size of shell: 1 inch. Original home: Mediterranean countries



Smithsonian photos

Fortunately, as an American your chances of catching this disease are extremely remote. The parasitic worm is not in this country as yet; nor are we certain that our species of fresh-water crayfish could serve as intermediate hosts. Nor can we say that many Americans are in the habit of eating raw river crayfish! Lithia Spring may be swarming with Thiarid snails, but it is still a perfectly safe and charming place to swim.

How did this oriental snail find its way to Florida? Back in 1936, a California aquarium dealer had been importing exotic water plants and tropical fish. In one of his shipments from some Pacific or East Indian island, one or two of these snails arrived. At first they were unnoticed, but later they were obvious by virtue of their powers of reproduction. A visiting dealer from Tampa, Florida, was struck by the oddity of these snails. Their elongated, reddish-brown shells are not unattractive, and the snail is able to produce tiny young alive. Within a year or so, this species was being sold as the "Philippine Horn of Plenty." The Tampa dealer occasionally refurbished his tanks with local aquatic plants, and during a foray to Lithia Spring, a wooden collecting tub was cleaned at the edge of the spring. One oriental snail was enough. Within a few years, a budding colony had increased to a density of 400 individuals per square foot.

A study was made of the life history of *Thiara granifera* to determine its capabilities of spreading to other parts of the country. The exact mode of reproduction is still a mystery. To date, we have not found sperm; in fact, we have found no males. Either the snail reproduces without the intervention of the male, or there is a fleeting period of maleness in the early life of the individual. Both types of reproduction (parthenogenesis and protandric hermaphroditism) are known in species of this general type of snail. We do know, however, that developing eggs are stored in a brood-pouch just under the skin on the back of the mother. A molluscan kangeroo! The tiny, red-shelled young may be seen through the skin of its parent, crawling about this protective chamber. The young snails emerge, on the average of one every day, through a small birth pore located on the right side of the mother's body.

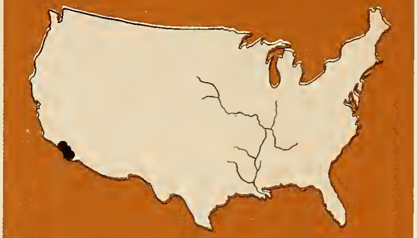
It was discovered that this snail perishes in water temperatures below 70 degrees F. The spring water at Lithia is always about 75 degrees F., but the near-by river into which it flows is well below this temperature and serves as a barrier against further spread of the snail. Birds or man may introduce it to other warm springs, however. In Tampa, the overflow from the commercial tanks supports this species during the warm summer months, but winter chills wipe out these few scouts each year. It is reasonable to expect that this snail will limit its Americanization to a few isolated cliques in remote warm springs of the Southeast.

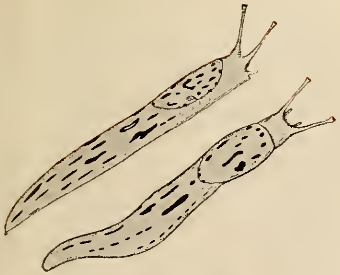
In all, we may breathe a sigh of relief with regard to this latest invader. It does not constitute an immediate menace to our public health. However, other snails, such as *Australorbis*, which would make an attractive aquarium pet, and the Japanese "schisto snail," *Oncomelania*, are far more dangerous. The disease they carry, the blood fluke, is much more serious and is acquired by merely bathing in infected waters or dipping one's hands in the fish bowl. The river systems of the Midwest would probably be ideal colonization grounds for several of these snails. Fortunately, the sanitary habits of Americans reduce the possibility of widespread establishment of the blood fluke, although this disease might be perpetuated by dogs and wild animals which can serve as reservoir hosts.

Four, and possibly more, fresh-water introductions have occurred in the United States, although the origins of many remain obscure. Most aquarium fanciers are familiar with the live-bearing Japanese snail (*Viviparus malleatus* Reeve), but few realize that this greenish-brown, golfball-sized mollusk has established itself in several American localities. They were first imported alive from Japan to the Chinese markets of San Francisco in 1891 for food purposes. By 1900, they were firmly entrenched throughout the artesian belt from San José to San Francisco. In the East, they were first discovered by

WHITE GARDEN SNAIL (*Theba pisana* Müller)

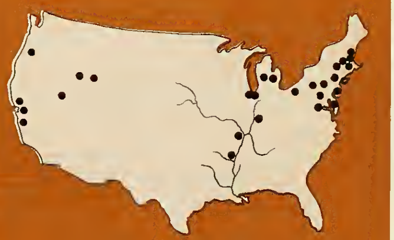
SO FAR, this species is found only in Southern California, where it was first noticed in June, 1914. It multiplies rapidly and becomes a nuisance by partially defoliating trees of citrus fruit, although no serious damage seems to have been done. Color: ivory-white with broken bands of light brown. Size of shell: 1/2 inch. Original home: Mediterranean countries





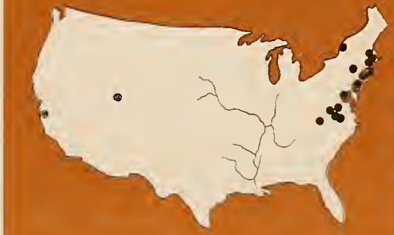
SPOTTED GARDEN SLUG (*Limax maximus* Linné)

THIS IS ONE of the dozen European species of slugs that have established themselves in many parts of the United States. The Spotted Garden Slug does great damage at night to gardens and mushroom beds. During the day, it hides in open cellars and under boards. Color: yellowish-gray with black spots. Length when extended: 3 to 5 inches. Original home: Europe



BANDED WOOD SNAIL (*Cepaea nemoralis* Linné)

EARLY SETTLERS may possibly have introduced this pretty land snail many years ago. Colonies still thrive in a number of eastern towns. Apparently it does little, if any, damage to gardens. Color: yellow to pinkish-tan with chestnut to black-brown bands. Size of shell: 3/4 inch. Original home: Northern Europe



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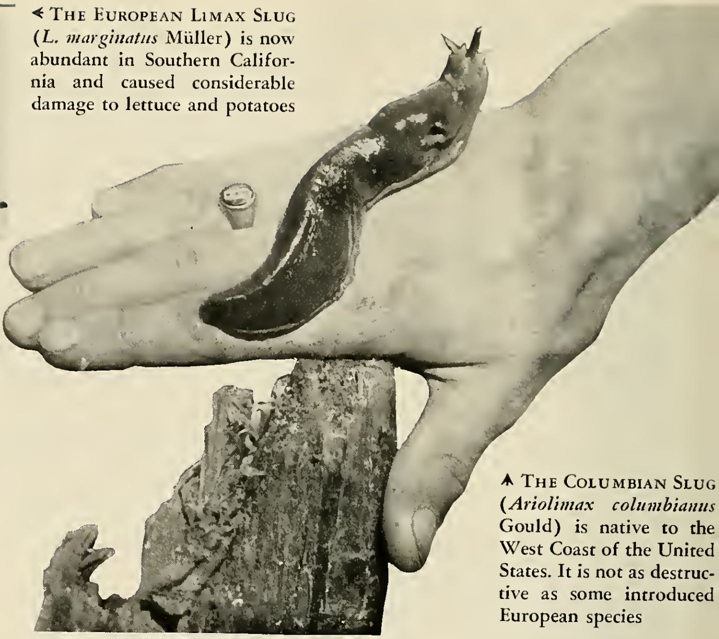
< The European Limax Slug (*L. marginatus* Müller) is now abundant in Southern California and caused considerable damage to lettuce and potatoes

Courtesy of H. A. Pilsbry



▲ The Columbian Slug (*Ariolimax columbianus* Gould) is native to the West Coast of the United States. It is not as destructive as some introduced European species

Smithsonian photo

Dr. William J. Clench, Harvard's mollusk expert, in April of 1914, in the Muddy River of Boston's Fenway. I have collected many beautiful specimens there as late as 1942. A colony may still survive in Lake Quinsigamond, near Worcester, Massachusetts, where it was first reported in September, 1917. This "escape" has also been found in Fairmount Park, Philadelphia (1925), St. Petersburg, Florida, and near Niagara Falls, N. Y. (1942).

"Among those also present" is a fresh-water corbicula clam from Japan, which is doing well in the Columbia River, Washington, and a small valvata snail, which is now widespread throughout the Great Lakes region. A small, left-handed pond snail, *Physa acuta* Draparnaud, has occasionally journeyed from Europe and temporarily set up egg-laying in eastern cities.

Even some of our common seashells are not native to the United States. Every visitor to the rockbound coast of New England who has observed the denizens of the tidepools is familiar with the common periwinkle, *Littorina littorea* Linné. Its "Plymouth Rock" is unknown, although it was first found at Pictou, Nova Scotia, in 1840. From Nova Scotia it spread rapidly southward, its pelagic early stages being carried in the plankton by the Labrador Current. By 1892, it had reached its southern limits at Atlantic City, New Jersey. In exchange for this European student, we returned (accidentally, of course) to England an American citizen, the dreaded oyster drill, which annually kills a million dollars worth of oysters. This was hardly sporting on our part, but while we were making apologies, an even larger and more destructive drill, *Ocinebra japonica* Dunker, was brought in from Japan and has established itself in several bays of Puget Sound. Such is the price to pay when introducing "bigger and better" oysters from foreign lands. Pests always come with them.

Land snails, however, stand foremost as successful immigrants, and Californians who take pride in their beautiful gardens can surely wax eloquent on the European brown garden snail, *Helix aspersa* Müller. A great deal of expense, both private and public, has been incurred in the battle against this vegetarian. This species is probably the most widely traveled of his clan, since it is one of the elite "escargots" or edible snails of France. Wherever the "fleur-de-lis" has been unfurled, this species has been among the wit-

Courtesy of H. A. Pilsbry

➤ The White Garden Snail (*Theba pisana* Müller) is from the Mediterranean countries. It has caused partial defoliation on California citrus trees and other plants

nesses. *Helix aspersa* first reached the United States at Portland, Maine, in 1839 and was last seen there in 1936. Its most successful landing was made in 1856, when it was introduced for food purposes at San José, California. It arrived in New Orleans from Spain and in Massachusetts from Ireland.

Several other land snails have become permanent residents, some quite a nuisance, such as the white garden snail, *Theba pisana* Müller, which partially defoliates citrus trees. The distribution of the various species follows the temperature and humidity gradients that best suit them. The Spanish edible snail, *Otala lactea* Müller, which is accustomed to the warm, dry areas of the Mediterranean, has had ample opportunity to establish itself from Montreal south, but it has gained a foothold only in such southerly localities as Cockspur Island (Georgia), Houston (Texas), St. Petersburg (Florida), and Los Angeles. Should the giant African snail make its entry into the United States, it is my opinion, which may differ from that of other malacologists, that the southern third of Florida is the only suitable area for its survival for any great length of time. Recent accounts of the invasion possibilities of this giant border on the hysterical, although I do not wish to minimize the importance of keeping a watchful eye on snail invaders.

The unattractive slugs of Europe have done well for themselves in America. Eleven or more species are now firmly entrenched on our soil, and a few of them are found in nearly every state in the Union. Public enemy numbers 1, 2, and 3 are the spotted garden slug, *Limax maximus* Linné, the true garden slug, *Deroceras,* and the tawny garden slug, *Limax flavus* Linné. These European colonists retain their gregarious habits and in certain local areas are able to build up their numbers to very destructive proportions within a relatively short time. The American species, on the other hand, are less socialized and are, for the most part, solitary in habit and much less destructive.

Once here, foreign snails have many opportunities for further dispersal. Inspection of the bases of potted palms and other plants in hotel lobbies will often reveal such tiny aliens as *Subulina* and *Lamellaxis.* Transplantings, market crops, lumber that has been stored in seaboard cities, water cress grown in the south and shipped north each season—these and dozens of other transportation activities help spread molluscan pests.

Despite the iron-clad laws now in existence to keep out disease-carrying snails and the fine-toothed combing given agricultural shipments from abroad, it is perfectly natural that a few molluscan Dillingers are going to dodge the long arm of the quarantine laws. Our best protection is to continue our vigilance at our borders, which at present is as efficient as is humanly possible, step up our research on snails and their control, and familiarize agriculturists and aquarium dealers with the snail problem through the medium of popular articles.

Saving Your Garden From Snails

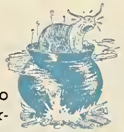
DESTROY 'EM!

The vast majority of species of snails stay in the woods and mind their own business, but not infrequently a row of garden lettuce or celery falls prey to hungry immigrant snails or slugs. One of the most successful poisoned baits consists of one ounce of metaldehyde to three pounds of wheat bran or "dry cereal," slightly moistened and scattered over the infested area. If small children or animals have access to your garden, scatter it thinly and not in large lumps or balls, since metaldehyde is mildly poisonous to warm-blooded animals.

Eliminate the snail's favorite haunts such as piles of old boards, bricks and stones, and dense, low-growing vegetation. Keep spaces beneath porches dry, and seal up chinks in basement walls. Hand-picking at night with a flashlight also helps.

Write to the Superintendent of Documents, Washington 25, D. C., for "Land Slugs and Snails and Their Control," Farmers' Bulletin No. 1895, by W. H. White and A. C. Davis. Price, five cents.

EAT 'EM!



The thought of eating snails is enough to break the courage of the hungriest American; but in Europe, "escargots" are eaten by the million each year, and in France snails are a national delicacy. Any snail is safe to eat if fresh and cooked. The secret of success with snails is in their preparation for the table.

First the snails are boiled in the shell for five minutes, after which they are removed, cleaned of the softer parts, and then reboiled for two hours. Leave whole or mince. Make a paste of butter, a considerable quantity of good olive oil, chopped parsley to taste, and a small quantity of minced eschalot or small onions. Thoroughly clean the empty shells and then stuff with snail meat, closing the aperture with a plug of the butter paste. In this condition they can be kept for some time in the refrigerator until ready for cooking. Simply heat them for about ten minutes over a hot fire, which literally broils the meat in the butter paste. Serve six to eight shells to a person; garnish plate with greens or salted crackers. Believe it or not, these snails taste very much like broiled oysters.

Other intriguing recipes, methods of farming snails, preparation for market, and other interesting facts are found in "Edible Snails" by E. W. Rust, Department of Agriculture Yearbook for 1914, Separate No. 653.

THE KIWI—

New Zealand's Flightless Oddity

Nature's unbelievable Believe-It-Or-Not, the kiwi—most unbirdlike of living birds and a twentieth-century anachronism. Even scientists insisted, "There ain't no such creature"—only to find it more fantastic than they had imagined

By Vion *and* Bernard Schram

At a crucial point in the Pacific war, supplies for the New Zealand troops stationed on New Caledonia failed to arrive on schedule. Familiar with military mix-ups, the supply sergeant began a canvass of other allied depots.

He inquired at the American base, "Are the Kiwi supplies here?"

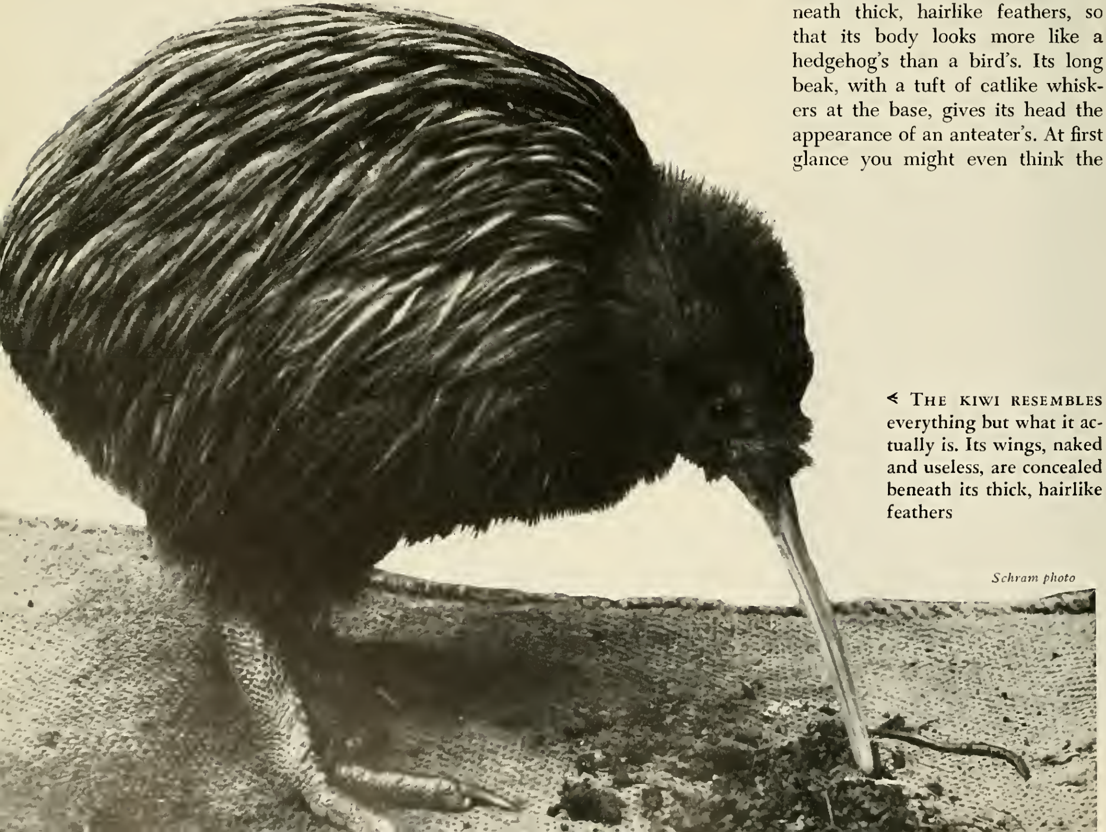
The bewildered Yank in charge scratched his head and asked, "*Whose* supplies?"

Then, after a moment's thought, enlightenment dawned.

"Oh, you mean those boxes with the picture of a long-nosed, flat-bottomed duck marked K-one-W-one?"

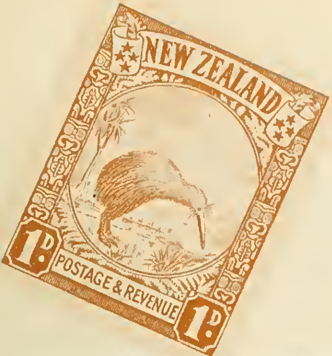
The "flat-bottomed duck marked K-one-W-one" was none other than New Zealand's national emblem, a creature almost as out-of-date in modern times as a dinosaur, and the exclusive pride and joy of New Zealand, the only place in the world where kiwis are found.

Even ornithologists label the kiwi "the queerest and most unbirdlike of living birds." It resembles almost everything but what it actually is. Unable to fly, the kiwi's naked and useless wings are concealed beneath thick, hairlike feathers, so that its body looks more like a hedgehog's than a bird's. Its long beak, with a tuft of catlike whiskers at the base, gives its head the appearance of an anteater's. At first glance you might even think the



< The kiwi resembles everything but what it actually is. Its wings, naked and useless, are concealed beneath its thick, hairlike feathers

Schram photo



NATIONAL EMBLEM of New Zealand, he awkward kiwi graces a Government tamp. New Zealand is the only place in he world where the bird is found

National Publicity Studios, Wellington

▲ TWO KIWIS: a New Zealand serviceman and his namesake. Somehow the country's armed forces were named "Kiwis," and the label stuck. Only airforcemen resented being named after a flightless bird

skin was a mammal's rather than a bird's. It is tough and leathery enough to be made into gloves and moccasins.

Very few foreigners and not so very many New Zealanders have seen a kiwi. Because of its timid love of darkness and its habit of digging rabbit-style burrows for daylight nesting, the kiwi was called "the hidden bird" by the Maoris, who thought it was under the special protection of Tane, god of the forest. However, this did not prevent these Polynesian hunters from tracking down kiwis for food and for their feathers, from which cloaks were made. Some of these early Maori cloaks, woven from native flax and kiwi feathers, are still in good condition though they were made as long as 200 years ago—a tribute to the durability of the kiwi's hairlike plumage.

The Maoris named the bird kiwi in imitation of its cry—a shrill whistle that sounds like *keeeee-wheee.*

Before the advent of the white man in New Zealand, kiwis abounded, despite large numbers slain by the Maoris. Fortunately, from a kiwi's point of view, New Zealand had no native mammals or reptiles to prey upon it, so that it was as safe from attack on the ground as in the air. Thus it was able to survive as a curious, earthbound bird, with vestigal wings measuring hardly two inches in length.

The downfall of the kiwi resulted from the nostalgia of English pioneers who longed for their familiar sports. Soon after establishing themselves in New Zealand, the settlers introduced all manner of foreign birds and animals to provide themselves with good hunting quarry. But they made one grave mistake: they loosed English rabbits and hares upon the countryside. Living up to their reputation for fecundity, the rodents soon multiplied until they became pests, threatening farm crops and ruining gardens. So the settlers promptly brought in stoats and ferrets to control them. This step also proved a boomerang.

The weasels quickly discovered that the native New Zealand birds, made unwary by centuries of life without ground enemies, were easier prey than the rabbits. The kiwi, which had the added disadvantage of being unable to fly, was almost entirely at the mercy of the imported killers. In short order, the kiwis' numbers were so reduced that New Zealand bird lovers feared they were doomed to extinction.

Yet another menace came from an unexpected direction. In their enthusiasm for sports, the New Zealand pioneers introduced American and European trout into their streams and lakes. In their avid experimentation in quest of artificial flies with trout appeal, they decided, with the inexplicable logic of the fisherman, that the drab brown and gray feathers of the kiwi made lures irresistible to the fish. Consequently, they scoured the countryside with dogs and guns, slaughtering hundreds of kiwis for their plumage.

As a result of these onslaughts

from all directions, kiwis became a curiosity instead of a commonplace bird in New Zealand.

By 1908, the kiwi had become so rare that a law was passed making it illegal for anyone to "take or kill" a kiwi without special government authorization. The law was weak and subject to widespread violation, so that in 1921 a new act was passed, which proclaimed the kiwi an "absolutely protected bird" and made it illegal for anyone to possess stuffed specimens, feathers, eggs, or Maori handicraft objects made with kiwi feathers, without permission from the Minister of Internal Affairs. The law also prohibited, on penalty of a $100 fine, the making of trout flies from kiwi feathers. A ban on exportation of the birds has been in effect since the 1908 law.

These laws, rigidly enforced by New Zealand's wildlife rangers, have helped to check the decline of the kiwi population, although the stoats and ferrets continue their raids. Conservation enforcement is difficult in any land. Dogs destroy large numbers, and vigilance for the welfare of the kiwi will continue to be necessary.

From the initial word of its existence brought to Europe by early nineteenth century explorers, the kiwi has been the object of curiosity and incredulity. Zoologists expressed frank disbelief in the existence of this "ball of fur on two sticks." Even when Captain Barclay of the ship "Providence" brought a kiwi skin back to England in 1812, scientists imitated the farmer who, seeing a giraffe for the first time, stoutly maintained, "There ain't no such animal." Later, when a live kiwi was presented to the London Zoological Garden, they were forced to admit that the fantastic bird actually existed.

Kiwis then became the rage among bird fanciers. Lord Rothschild collected a number of specimens for his private aviary. The Emperor of Austria and Hungary secured a pair for his personal zoo. Collectors and zoological gardens all over the world vied in procuring the weird birds.

All had the same experience. The nocturnal birds lived for only a short time in captivity, and none produced young, even though one obliging kiwi in London sat on an infertile egg for 114 days before admitting defeat.

But the kiwi egg proved as great a curiosity as the ungainly bird itself. One species of kiwi weighs only five or six pounds at full maturity yet lays an egg weighing a pound or more—almost a quarter the size of the bird itself. So dis-

Photos courtesy New Zealand Legation

▲ Kiwis burrowing for worms. By the age of three months, the baby kiwi consumes one and a half pounds of worms a day—or 800 of them

◀ The elongated beak comprises nearly a third of the kiwi's total length. So acute is the bird's sense of smell that it can locate worms underground before driving its bill into the earth proportionately large is the egg that just before it is laid, the overladen hen staggers under the weight like a drunken sailor in a gale. Even the ostrich, which may weigh as much as 250 pounds, lays eggs that are only slightly larger; and the domestic turkey, a much bigger fowl, lays an egg less than a third the size of the kiwi's.

It was only three years ago that the first kiwi chick was hatched in captivity, enabling scientists to report that the kiwi male is easily the most henpecked husband in the world.

The credit for this achievement goes to F. D. Robson, Curator of the Hawkes Bay Acclimatization Society's game farm near Napier, New Zealand. An expert in raising pheasants and trout for release in the Hawkes Bay area, Robson acquired—illegally, it may be added—his first kiwi some seventeen years ago. It was a fully grown, five-year-old cock that had been captured by pig hunters, who kept it secretly until it escaped. The frightened fugitive bird was found huddled in a Napier factory coal bin and was turned over to Robson. Curious to learn the habits of the rare creature, Robson ignored the law requiring him to report possession of the bird to the wildlife officials.

Robson kept his kiwi for six years, until he was fortunate enough to acquire a badly injured one-month-old chick that had been caught in a bush fire. He carefully nursed the chick, a hen, for five years until she reached maturity. She then started on an egg-laying spree that refuted all authorities who had previously claimed the kiwi could lay but one of its monumental eggs per year. Within a four-month period, Robson's hen laid four eggs — all of which, however, proved to be infertile.

By this time, word of his under-the-counter kiwis reached the ears of the authorities. Considerable controversy arose, with the influential Hawkes Bay Acclimatization Society taking Robson's part. At length, a special cabinet meeting handed down a decision that Robson could keep his pets in order to observe their breeding habits, on condition that he provide the Department of Internal Affairs with semiannual reports on his findings.

On September 19, 1945, Robson announced an event that held as much interest for New Zealanders as the Dionne quintuplets for the Canadians: the first kiwi was hatched in captivity. Unlike Papa Dionne, whose role had been all but ignored, Papa Kiwi came in for the lion's share of the credit.

For weeks, New Zealand newspapers printed almost daily reports on the progress of the setting, and editorials featured the brow-beaten male kiwi as the most notable victim of female emancipation.

As Robson describes the situation, "After Mama Kiwi laid the huge egg, she lost all interest. It was Papa Kiwi who made the nest and sat on the egg for 80 days until it was hatched. Sometimes he wouldn't leave the nest for a week, going without food, and at the end of the ordeal, he had lost two pounds in weight. He didn't look much bigger than the chick when it was hatched.

"While he was on the egg, he was so maternal he'd attack anyone who approached him, and the only time the hen came close was just before the egg was hatched. One day she came to the box in which the male was nesting and rapped on the outside with her beak. He replied by tapping on the box from inside. They must have been using some kind of Morse code, because she went away satisfied and took no further notice of the incubation."

Insult was added to injury for male vanity when the kiwi hen laid a second egg only 26 days after the first, just when the poor male had gotten well settled on it. As a consequence, the harassed husband had to extend his vigil to 100 days, at the end of which not one but two chicks had been hatched. Last season he had an even worse ordeal. Five eggs were laid over a period of six months, and the male bird sat continuously for 185 days.

News of the new arrivals traveled round the world among bird circles. In America the tale of the kiwi chicks and the birds' gigantic eggs caught the eye of an enterprising poultry farmer. Without delay he wrote to Robson requesting all details, with an eye to crossing kiwis with his hens to produce larger eggs.

"When he heard that kiwis only lay a couple of eggs a year, he lost interest," Robson reports.

Since then Robson has been assailed with bids for the kiwis, which are really wards of the state in his custody. One American bird fancier has offered $1200 for a fertile kiwi egg and promised to arrange for its delivery to the States by air. More recently, an American tourist, a little the worse for a farewell shipboard party, landed in Auckland and demanded to know, "Where can I buy one of these kiwi birds?" Undismayed at the news that kiwis were not for sale anywhere, he lurched down the street, proclaiming, "I'd give $50 for one of these d———d birds."

All such proposals, including a patriotic suggestion to present a pair of kiwis to Winston Churchill in appreciation for his war services, have been politely rejected.

Wildlife officials point out, "The kiwi is not a bird that adapts itself to exhibition. It is a night bird, accustomed to sleeping during the daytime, just when people would want to see it. Moreover, its food demands are such that it does not appear to thrive on a strange diet. Therefore, no kiwis are being released for zoos."

In reality, the Wellington Zoo has two kiwis on a basis of dubious legality. Residents of the zoo for many years, the kiwis roam the bush adjacent to the menagerie area. They are caught on rare occasions for display to important visitors and were penned for some months for the benefit of American troops stationed in New Zealand. When queried about the kiwis, the curator innocently lifts his eyebrows and protests, "We have no kiwis in captivity. There may be wild ones on the grounds, but we can't be responsible for them."

However, the kiwis' presence is all too well known to the zoo gardener. The birds have taken a fancy to his rose garden, in the beds of which they probe nightly in quest of worms. Lately, they have developed an unaccountable taste for rosebush shoots and, much to the gardener's dismay, have completely stripped the plot of young plants.

Robson is a whole-hearted sympathizer in regard to the kiwis' "food demands." The baby kiwis at the game farm are born weighing only six to ten ounces. During the first four days of their life, they are too weak to support themselves on their own legs, and Papa Kiwi, who by this time has had enough trouble with them, doesn't bother to feed them. On the sixth day, the chicks stalk out on their own and start boring into the ground with their beaks in search of worms. For the first two weeks of their life, they lose weight. Then they commence to gain, and at the end of three months they each consume one and a half pounds of worms a day.

The daily worm diet for the chicks, with slightly less for the adults, keeps Robson hard at work. Although he stumbled across the expedient of "planting worms" by burying bits of meat from which maggots hatch, he still spends many hours engaged in worm digging.

"Do you know how many worms it takes to make a pound and a half?" he asks ruefully. "It takes 800."

His kiwi brood now numbers six —the original pair, three of their offspring, and "Pegleg Pete."

"Pegleg Pete" is a recent acquisition. Some months ago, he was caught in a possum trap, which broke his leg. The trapper turned the injured kiwi over to the conservator of game, who was forced to amputate the broken leg in order to save the bird's life. Then it was sent to Robson.

Robson has ingeniously devised a pegleg for the bird by whittling a hollow joint of bamboo to fit the stump and making it fast with a piece of rubber tubing. Today "Pete" hops around so agilely on his pegleg that he frequently eludes Robson when the curator seeks to catch him in the large enclosure housing the kiwis. Consequently, Robson sometimes has to resort to trickery. Sighting the bird, Robson will make a scratching noise on the ground to startle him. When the myopic kiwi charges blindly forward, Robson jumps to one side. The bird butts into the wire fence, and the curator captures him before he recovers his balance.

Robson has his own theory about why kiwis lost the power of flight. He bases it on the fact that the kiwi has very poor eyesight—with a range of vision limited to about two feet in daylight and six feet at night. He states that a bird so blind could never fly in the forest without killing itself.

Despite its groundling status, the kiwi is a well-qualified sprinter. It easily outdistances an unmounted man and can hold its own against dogs. Most kiwis that are captured by dogs are surprised during daylight when they are asleep in their burrows.

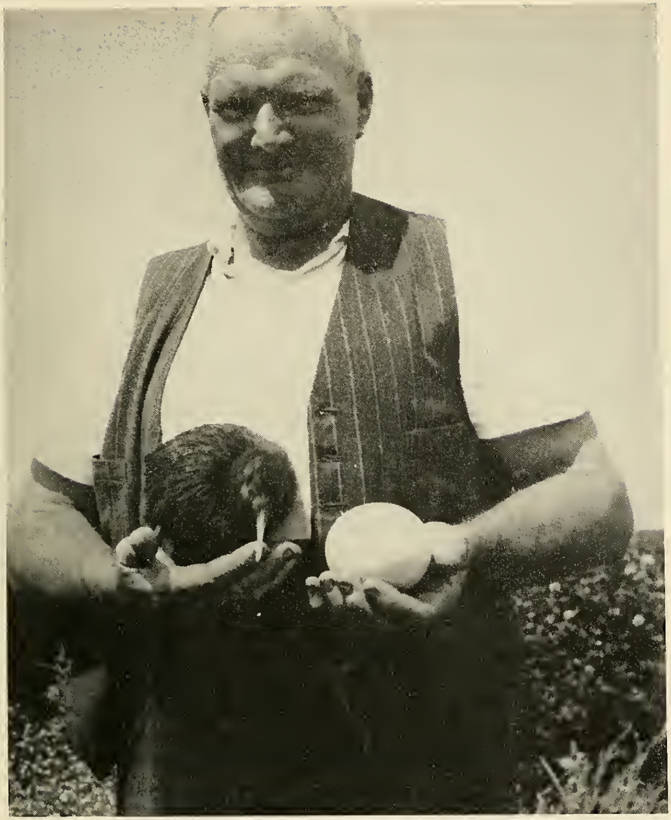
Although a subject for zoological study for more than a century, the kiwi has been seen in a live state by relatively few ornithologists. Those who have seen the bird at close quarters find the kiwi so ludicrous in appearance that they are moved to attempts at whimsy, even in scientific writings.

The noted New Zealand naturalists F. W. Hutton and James Drummond felt called upon to assert: "Not a bone in its frame or a muscle on its ungainly body, and hardly a feather of its hair-like plumage has escaped minute and elaborate description. Its innermost private life has been invaded; and its habits, its clumsy gait, its wretchedly defenseless condition, its family failings, its deformities and malformations have been made public."

Like a Walt Disney character come to life, the kiwi literally sniffs its way through life, depending on its keen sense of smell to guide it, in compensation for its pitifully weak eyes. To facilitate this, the nostrils are in the very tip of the elongated beak, which comprises nearly one-third of the bird's total length. With audible snorts, the kiwi wobbles ungracefully along, its beak inquisitively probing the ground at each step. Its sense of smell is so acute that it literally smells worms underground before driving its bill into the earth.

▼ **THE MOST HENPECKED HUSBAND** in the world: Papa Kiwi incubating an egg. After the egg is laid, the female loses interest, and the male is saddled with all responsibility until the hatching

Courtesy New Zealand Legation



▲ **The gigantic egg is out of all proportion to the kiwi—almost a quarter the size of the bird itself**

Schram photos

The kiwi runs like a novice tightrope walker, placing each foot exactly before the other in a straight line, while its tailless rear sways wildly from side to side in a feathery burlesque of the cancan.

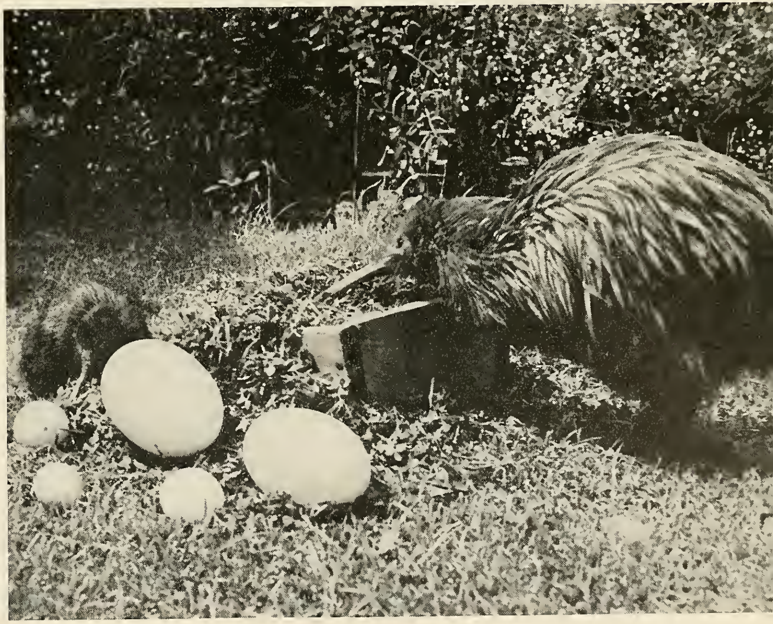
Had it not been for the war, popular interest in the kiwi would probably have remained confined to New Zealand. But before the war ended, every newspaper reader and serviceman knew the gallant New Zealand fighting forces as Kiwis.

There are numerous theories as to how the name Kiwi came to be generally applied to the New Zealanders fighting all over the world. One story says that the term was first applied to them by their Australian neighbors. Another attributes it to the popularity of an English shoe polish using the kiwi as a trademark and brand name. This version has it that Arab servants employed in polishing New Zealand officers' shoes in North Africa began calling them all "Mr. Kiwi."

Regardless of origin, the term quickly gained acceptance and was applied to all New Zealand forces on land, sea, and in the air—much to the disgust of airforcemen, who resented being named after a flightless bird. Soon American and English airmen were calling their own ground crews Kiwis because they did not fly.

When the Pacific battle started, the term was so popular that the New Zealand Third Division on duty against Japan boasted the kiwi as an official insigne. They published a service newspaper entitled "The Kiwi News" and received all their mail and supplies with the kiwi stenciled on the containers. German propaganda leaflets dropped for New Zealand troops

▼ **Study in contrasts: hen's eggs and kiwi's. Even the domestic turkey, a much bigger fowl, lays an egg less than a third the size of the kiwi's**



in Africa addressed them familiarly as Kiwis and featured illustrations of the national bird. Military cartoonists habitually used the kiwi to symbolize New Zealand forces.

When New Zealand troops retreated from Greece after a valiant but futile holding operation, they sadly remarked, "We kiwis can't fly, but, by God, we can run."

Today the kiwi is prominent in every aspect of New Zealand life. Its awkward figure graces stamps, bank notes, and coins. Business firms using its name range from the Kiwi Dental Repairs Company to the Kiwi Cake Kitchen. It has been adopted as the distinguishing mark of the New Zealand Manufacturers Federation and appears on all products made by the organization's members.

At least one noteworthy New Zealander, however, takes issue with all this kiwi-consciousness. He is Arthur P. Harper, President of the Forest and Bird Protection Society of New Zealand.

"America has her eagle that stands for freedom," he says. "Britain has the bulldog to signify tenacity. We've adopted a beastly bird that isn't even good to eat."

Harper, an eighty-four-year-old New Zealand pioneer, ought to know. Credited with opening up large regions of New Zealand through his exploration in the last century, Harper has spent most of his life in the native bush along with the kiwis. In the old days, he ate kiwi on many occasions.

"It tastes terrible," he reports. "Like an old piece of pork boiled in second-hand coffee."

CANYON UTOPIA

Continued from page 79

able land will devote several acres to raising the feed needed for the ponies. Bert Jones, our twenty-one-year-old guide, boasted that he and his father owned a couple of hundred head of stock, most of which ran wild on the mesa above and were rounded up only when tourist demands made additional stock necessary.

Visitors, who have been coming to Havasu in increasing numbers in the last decade, provide a modest revenue for the Indians. These visitors require pack animals, saddle ponies, and guide service, all of which mean a small but steady income for the Indians. Since visitors are few as yet, the proceeds from this source are necessarily small, but they are a welcome addition to the villagers' meager income and explain their friendliness to outsiders. The Indians round out their income by taking occasional jobs on the plateau above. Most of the young men do seasonal chores for the National Park Service. They also engage in a little horse trading, do work on the roads, or fill a variety of simple jobs that earn an honest dollar. However, Havasu Canyon is home to them, and they always return in time for the planting and later for the harvesting.

Despite their sometimes pinched conditions, the Havasupai are a happy people. Their needs are few and simple. They have their own local law enforcement machinery, a school for their children, and a government agent who devotes his whole energy to supervising their welfare. Besides the white man's law as embodied in the subagent, the Havasupai have their own representation in the form of a local council. This body consists of seven members, including three hereditary chiefs who serve for life and four others members elected annually by popular vote. The council handles the minor affairs of the tribe and has jurisdiction over certain phases of the Indians' life — although every major proposal must have the approval of the Superintendent of the reservation.

The only local vice is gambling, and the whole adult population indulges. A closely-knit people like the Havasupai have little home life as it is understood by other races. Their pleasures are derived from gathering with the other members of the community. Around two every afternoon they begin to assemble at a clump of cottonwoods near the stream. Soon the whole village is there, squatting cross-legged in the shade. Here on blankets and sheepskins laid out on the ground, they begin the gambling, men and women smoking their hand-rolled cigarettes and noisily making their bets. A man may leave off work during the heat of the afternoon and sit in on a session of cards, returning to his fields when the heat has subsided.

They play a complicated game, in groups of seven, with each player holding ten cards. Though they gamble for small stakes, they play with great enthusiasm and good humor and gather up their winnings with the eagerness of laughing children scooping up marbles. The winnings go into groceries and clothing and jewelry and trappings for their horses. The village has a buying co-operative, and once a month the agent goes outside to Williams or Flagstaff and brings back the supplies. The people have a spirit of friendly co-operation, though they do not share their winnings.

Besides the daily gambling, the Havasupai have few diversions. They take part in the annual Pow-wow at Flagstaff, in which they always enter a few riders and generally make out well enough. They also have two or three ceremonial dances. These dances are not necessarily religious in nature. One festival celebrates the fruit harvest and is purely a social affair. The Havasupai are not outwardly pious, although like all Indians they are inherently religious and have their own version of the stories of the Flood and the Creation.

The Supai are not a picturesque people, as Indians go. They have few tribal traditions, few legends, and no native costume. The women dress in shapeless Mother Hubbards and generally go barefoot. The men, because of their contact with visitors, dress more picturesquely, wearing the traditional cowboy riding outfit of broad-brimmed Stetson, blue jeans, colorful shirt, and gay neckerchief. They belie the Indians' reputation for stolid silence by being a friendly and even talkative people. They are quick to smile and laugh, and greet strangers cordially. Even the women show a friendly attitude toward whites—something rare in Indian behavior.

Visitors are still a novelty to the simple villagers, who cannot understand what makes whites so inordinately curious. The old men question visitors eagerly concerning the outside world. The women, like women the world over, sit and gossip with the neighbors. Squatting on the bare ground, they mold the tortilla-like loaf of bread which is their chief item of food and which is fried over an open fire out-of-doors—where all cooking is done.

The pastoral seclusion of this desert utopia is in little danger of being interrupted by an immediate foreseeable circumstance. Since Havasu Canyon lies within a reservation, which in turn is embraced within a national park, the little settlement would appear to be doubly secure from the encroachments of all save those hardy adventurers who enjoy roughing it. While the village has sleeping accommodations for half a dozen, it has no provisions for serving meals. At the present time, visitors must bring their own food and bedding and be literally self-sustaining. Because of the limited accommodations, prospective visitors who prefer to sleep under a roof should write to the tourist-agent at Supai, Arizona, via Grand Canyon, in order to assure themselves of reservations.

Havasu Canyon is an outstanding scenic area. Below the village is the primitive region of rugged grandeur with its series of enchanting waterfalls, which are among the most beautiful on this continent. Only their isolated location has kept them from becoming a mecca for visitors. But the traveling public is catching on, and Havasu Canyon is due for a tourist boom. Faced with this happy prospect and with the innovations the Indian Service has in mind, the Supai of Havasu Canyon have little need to worry about the future of their canyon home. Under the watchful eye of the Indian and National Park services, they are likely to enjoy their present fortunate status—which is a combination of Eden, Utopia, and the happy hunting grounds—until the day the Supai Gods tumble from the canyon rim and crumble to dust in the sparkling depths of the Blue Water.

THOSE BAROTSE!

Continued from page 61

through a stately mopane forest and saw lion tracks, and we knew the lions would not be there unless there were game. Then we came upon buffalo spoor and were confident that our food troubles soon would end.

By late afternoon we had passed no village, seen no signs of man, until we reached, before sundown, a large boma—a clearing surrounded by a reed fence. Surely this must be M'Lumba's, the large village we had been told we would find across the border. Surely we must, at last, be in Portuguese territory and no more than a few days' walk from Tete. In so large a village, too, we should be able to trade for grain to feed our hungry carriers.

A scowling, unfriendly headboy and his two wives greeted us. It was M'Lumba, and he and his women brought a fowl and a few eggs, for which I haggled while the men went hunting. A buffalo in camp would change the unfriendly atmosphere, so I turned away from the villagers and went about the business of making camp, although conscious that M'Lumba and his women hovered like vultures, waiting for further trading, and I knew that the problem of that evening's meal was not yet settled.

The hunters came in with a small waterbuck cow, which was no more than a tantalizing suggestion to 60 hungry boys. We brought out a few yards of calico, but M'Lumba saw our predicament and drove a hard bargain for very little grain. There were low mutters about the lack of food, the weight of the loads, the distance to Tete.

When it was dark, I picked up our last half sack of sugar, hoping that might tempt the surly M'Lumba.

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We had to keep the M'Curry Curry in a good humor and get the children through to the safety of the camp.

Shilling, brother of the Mudalla, stepped up and took the sugar sack. "You cannot sell that, Inkos," he said indignantly. "We are black boys. If we die it does not matter. You and the picannins must get through to Tete, and you must not sell your food. We can get along."

Those Barotse!

The campfire crackled, and it should have been a peaceful night, but it was not. M'Lumba said it was far to Chioco, the next village, and that there was no water on the way, which meant that there would be little game, if any.

Pocket, one of the M'Curry Curry, suddenly sailed over the fence into the boma, and Saiman and Mengeneera stormed through the gate in pursuit.

"This low-down cur of a M'Curry Curry is trying to run away!" exclaimed Mengeneera, stammering as he always did when in a rage, and he shook the boy whom he had tossed over the fence.

Holding Pocket in front of them, the 17 Barotse gathered to one side of the clearing, the 40 M'Curry Curry on the other. Then Pocket broke loose and made a dash for the gate, the rest of the pack on his heels. The M'Curry Curry were going home. It was mutiny.

The Barotse waded into the mutineers with knobkerries, spears, sticks, fists, stones, anything at hand. A seething black mass, licked with light from the fire, tumbled in a corner. Peter and Jonas were trying to choke one boy, holding him against the wall of a hut. There was no sound but the thump of stick against skull, the thud of a fall, heavy breathing, curses, grunts, and the gasps of 60 furiously battling men.

Outnumbered more than three to one, the Barotse were fighting for the right to dictate to the M'Curry Curry, and all our plans depended on the next few moments. Unless the carriers were beaten into going on, the only direction in which they would carry was toward Southern Rhodesia and home, or they might refuse to carry at all.

There was a sudden lull, and the mutineers crouched in a corner of the fence, the Barotse threatening them if they moved. Mafaeking stepped to the front of his "brothers" and held up his hand, spitting scornfully in the direction of the M'Curry Curry.

He drew himself to his full height, his coppery torso burnished by the firelight, and paused for attention. No one so much as coughed, and then he let his deep voice roll. "I, Mafaeking, Mafaeking of the Barotse, speak to you—baboons." Not a whisper stirred in the silence while he scored the M'Curry Curry for yellow deserters. Speaking for all Barotse, conquerors and men, he tongue-lashed the "baboons." He told them how men, like himself and his brothers, met crises and work to be done. He was arrogant with pride of race, his every gesture majestic. "You will go through to Tete." He delivered his ultimatum. "I, Mafaeking, hunter for Lewanika, king of the Barotse, tell you so. And the Barotse kill—so." He finished with a significant strangling gesture about his throat.

There was whispering in the corner, among the "baboons." Then Pocket, the first deserter, stood up.

"We have made a mistake, Inkos. We will go to Tete."

On the twentieth day after leaving the Mazoe River in Southern Rhodesia, we saw the wide, blue Zambesi. The Barotse had brought us through.

Those Barotse! Before I had left Portuguese East I was to learn more of their quality. And on returning to Northern Rhodesia two years later, to finish what remained in our dreams of life with game and camera, they again proved that they were men among men. They haunted me. What was it in Barotseland, I wondered, that produced these leaders?

A spell is a spell is a spell, and although I had to wait seven years, I turned to Africa for a third time. I was determined to go to Barotseland and finally answer my questions for myself.

So once again I was headed for country about which no one could tell me much, following trails that were vague even to officials in Livingstone. At that time, the usual route into their country was by paddling for three weeks up the Zambesi River. And so at last I reached the home of those Barotse and lived among them for three months, learning of their traditions and the freedom with which they live a life that is their own.

Some months after I left Barotseland, the Paramount Chief Yeta III, son of Lewanika for whom Mafaeking once hunted, wrote me. As is the custom, he addressed me as "My friend." "My friend," Yeta wrote, "since you have left my country, we are living in peace, all people whom you know."

When I was in Africa again not long ago, I was unable to get north of the Limpopo River, but I inquired about the Barotse from an old friend, who covers the continent with a camera and had been among them since my last visit.

"They're getting surly," he told me. "They're not the same people you knew. In the past few years the Recruiting Agents have been allowed to go in and hire them for the mines of South Africa. You would find changes if you went back."

The Barotse have gone out to work for years, so it is not just the mines, I thought sadly. At the mines, there is no one to respect them if they lift their heads and say proudly, "The Barotse are known." Who cares? They are but anonymous workers, supervised by men steeped in the doctrine of White Supremacy.

At the mines and in the factories there is no call for the forthrightness and courage of a conquering tribe. Their manhood is denied, and they are merely "boys," classed as unfit to share in that white man's world they once thought glamorous and desirable.

And yet, as a friend of mine in South Africa once sadly said of the African, "It would be so easy to make friends of these people!"

So I had found it.

Continued from page 50

I am bound to add, however, that I doubt if this particular account is actually true. My reasons are simple. The distance involved here is so great that the chances of an accidental return are very slight indeed. Furthermore, there is, so far as I know, no reliable evidence that would render this anecdotal material credible.

Of course, cats can find their way home from any point in the territory with which they are familiar. This is based upon simple learning and is no more mysterious than a child's ability to walk home from school. Genuine homing ability may be something quite different. We're not certain as yet whether learning can account for the capacity of some birds to fly hundreds of miles over strange country and eventually return to their own nests. This is not the place to enter into a discussion of the various theories that have been proposed as explanations of homing; but it should suffice to state, more or less categorically, that there is no valid evidence to suggest that cats possess homing ability as distinct from the ability to learn their way about the world in which they live.

Written by an eleven-year-old boy:

"Thank you Grandpa, for renewing my subscription to NATURAL HISTORY, which is my favorite magazine and it would be terrible if I had to stop getting it."

Regular and Special Lectures at the Planetarium

The regular lecture at the Hayden Planetarium during February will be entitled "Conquest of Earth." It will demonstrate the close relation between astronomy and geography and show how the stars have aided man in mapping the earth.

Also in February, five special lecture courses will begin, on the following subjects:

Modern Celestial Navigation	Wed., Feb. 1	7:15 P. M.
Applied Navigation	Mon., Feb. 6	4:00 and 7:15 P. M.
Young People's Astronomy	Sat., Feb. 18	9:45 A. M.
Why the Weather	Thurs., Feb. 23	7:00 P. M.
Astronomy Without Mathematics	Tues., Feb. 28	7:15 P. M.

These one-lecture-a-week courses are carefully streamlined to clarify basic concepts in an authoritative yet not too technical manner. The introductory sessions, on the dates listed above, are open to interested persons without charge. For further information, call or write the Hayden Planetarium.

▲ GULL TALK: an unusual photograph taken by Karl Stulcken in Germany

Art by the Inventor of the Telegraph

New Yorkers will be given the opportunity to view from 35 to 40 paintings executed by the talented Samuel Finley Breese Morse, between January 19 and February 28 at the American Museum of Natural History.

The exhibition is being sponsored by the National Academy of Design as a tribute to its first president, who distinguished himself in the world of art on both sides of the Atlantic long before he became more widely known as the inventor of the telegraph. The exhibition also serves to inaugurate the 125th year of the establishment of the Academy.

Samuel Morse was a prolific painter. There is no record of the number of paintings that came from his brush, but 307 are known to be in existence today. They are catalogued in private collections and museums in this country and abroad. His full-length portrait of Marquis de Lafayette, considered by some critics as one of his finest, hangs in New York City Hall. It is being loaned for the exhibition. Others of his works are coming from a number of the foremost museums and from the private collections of the Morse family.

The only sculpture known to come from the hands of Morse is a plaster cast of "The Dying Hercules," which he used as a model to paint the subject on a canvas measuring 96½ x 78 inches. These works were executed in London by Morse in 1813 and received highest praise from the London critics.

In the beginning of his artistic career, Morse had planned to devote himself to historical paintings, but after his return to America in 1814 he set out as a portrait painter. First establishing himself in Boston, then traveling through several New England towns in quest of sittings, he eventually opened a studio in Charleston, South Carolina, where he was very successful at first, having at one time more than 150 commissions in advance. His portraits include many of the distinguished personalities of his day.

Morse, the inventor, will be represented at the show by a large and well-planned display of his accomplishments in the field of science and invention. Valuable pieces from the Smithsonian Institution will be exhibited, including the first telegraphic instruments used; medals the inventor received from foreign governments (Morse was the most bemedaled man in American history up to his time); pieces of the original Atlantic cable; the first Morse camera, which he used as a pioneer in the field of photography while professor of Literature of the Arts of Design at New York University; and hundreds of other Morsiana items from educational institutions, libraries, and historical societies.

Museum Spring Dance Series

Dances from Europe, Asia, Africa, and America will highlight the spring program entitled "Around the World with Dance and Song" at the American Museum of Natural History.

Uday Shankar, generally considered one of the greatest Hindu dancers of all times, will open the series on February 9 with a program composed of new works and repertory favorites from other years. Mr. Shankar, a superb artist of rare caliber, recently completed an engagement at the Forty-eighth Street Theater in New York.

On February 23, "Mara," foremost exponent of Cambodian and Siamese dancing, will offer the intriguing "Apsara"—dying art of the lost Khmer civilization which mysteriously vanished centuries ago. Delakova-Berk and Company will appear on March 9 in dance scenes from Europe, America, and the Near East; and Kolya and Vinya will present authentic dances from Russia on March 23.

On May 4 Pearl Primus, just back from a year's expedition in Africa, where she studied native dances on a Rosenwald Fellowship, will offer an exciting group of African ceremonial and social dances based on her studies.

Dances and music of ancient India by Wasantha Singh, Indian scholar and musician, and his daughter, Lakshimi, will be offered April 20. And for the final program of the series on May 18, La Meri and Myra Kinch will present a group of new modern works based on traditional ethnic forms.

The series, to be held in the Museum's main auditorium, will include an afternoon program at 3:30 P. M., to which children are admitted, and an evening program given by the same artists at 8:30 P. M. All seats are reserved. Information regarding tickets may be procured from Hazel Lockwood Muller of the Museum's Department of Education: ENdicott 2-8500, Ext. 248.

Continued from page 55

tation of what is known about the question of racial superiority.

The greater part of the book lies under the heading of Part Four: "Primitive Society." Here, Subsistance and Crafts, Marriage and Kin, Status and Social Role, Property, Social Control, and Religion are subheadings, under which are grouped brief but clear discussions of principles and classificatory units. In most instances, the material is illustrated by the description of an appropriate portion of a primitive culture. There is not too much of this—just enough to clarify the point that the author wishes to make. While the emphasis in this section is on the simpler cultures, there is enough reference to our modern civilization to make it clear that the forms and mechanisms being discussed apply to present-day western culture as well as to that of the Bakongo.

Part Five, "Society and Culture," discusses some of the larger concepts developed in anthropology—Society and Culture, Culture Areas and Culture Systems, Personality and Culture, Invention and Diffusion—and then gives what is perhaps the best presentation of present-day concepts of cultural evolution that has appeared in a textbook.

The book is written in an interesting style and is relieved by occasional bits of humor, but the bit on page 101 doesn't help much. I would like to see authority cited for the statement that roasted and pounded ants are "known as Shoshone *ante-pasto.*" The book is arranged in effective textbook format with bold type subheadings.

James A. Ford

AUDUBON'S AMERICAN BIRDS

from plates by J. J. Audubon
- - - Edited by Sacheverell Sitwell

Batsford Colour Books, London, $2.00
12 pp., 16 illusts.

THIS slim volume, of crown quarto size, justifies the publisher's claim that it reproduces "directly, and with a fidelity of colour not hitherto achieved," sixteen selections from one of the finest illustrated works of all time. The exquisite plates were engraved and printed in the Netherlands. They testify to the marked superiority of European low-cost color work over any equivalent now obtainable in the United States.

The accompanying 12 pages (8000 words) of text by Sacheverell Sitwell are informing, discursive, gratuitous, stimulating (in the galvanic sense), opinionated, and sometimes exasperating. In the course of an essay dealing with ornithologists, artists, illustrators, authors, American Indians, New Zealand aborigines, game cocks (a masterpiece!), and what not, it is really possible to learn something about John James Audubon, his antecedents, collaborators, rank as a creative genius, and place in the Romantic movement that flowered contemporaneously in several arts.

It is no disparagement of the editor's sensitive appreciation of Audubon as a painter to point out how little Sitwell knows of birds and some other things. He extols the flowers in a number of the plates but omits, as did Audubon himself, to credit Joseph Mason, the lad who limned them around the master's birds. He informs us that the Carolina paroquet is "probably extinct"; that birds of blue plumage are rare in nature (which they are not). He obviously believes that our big American stork, the "wood ibis," is an ibis; that there is an "olive-sided nutcatcher"; that the wood duck and Carolina duck are different species. And he caps the climax with such solecisms as that the eider duck is more often found on rocky coastal islands than "in wooden swamps and hollow trees," or that "perhaps the African flamingo is a little paler, more roseate, than the American."

R. C. M.

A NEW THEORY OF HUMAN EVOLUTION

- - - - - - - - - - by Sir Arthur Keith

Philosophical Library, $4.75
451 pp.

THIS new book by Sir Arthur Keith attempts to present the story of man's evolution and his differentiation into races. In Keith's view, the essential mechanism that controlled this lengthy process of a million or so years was the psychological nature with which the forerunners of man were endowed. This was a combination of dual but contrasting biases (derived from instincts): love for one's own kind and hate for others, co-operation and competition, together with a variety of other impulses that enforced these. By virtue of these innate characteristics, men in the primal days of their evolution were immured in small, mutually hostile, and competitive bands which as a corollary meant that they bred within their own group, thus preserving and working out the destiny implicit in this genetic endowment.

The fossil record of man's history is also analyzed in detail, and the author concludes that the various races of today all derive their origin from Australopithicinae in Africa, became separated at an early stage and evolved independently within their present geographic bounds.

Finally, modern nationalism is pictured as a continuation of the original, inbreeding primal group whose evolutionary function it has taken over.

Unfortunately, the conception presented here abounds in unacceptable assumptions and is open to innumerable objections. One cannot help feeling that the reputation of the author has not been enhanced.

Harry L. Shapiro

March NATURAL HISTORY 1950

Mission: Malaria · Tar-Trap Treasure · Striking Rattler

How Dangerous Are Animals? · Sky Survey · Sea Parrot

Pageant of the Pacific

MAPS By Miguel Covarrubias

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LETTERS

"Monster's" Enemy

Sirs:

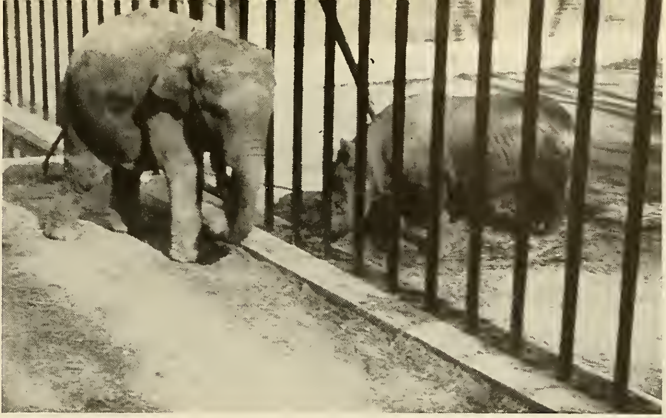
"Monster of the Mist Forests," in your January issue, contained the following paragraph on page 23: "Other than man, the black rhino has few enemies. However, one notable exception, or so legend has it, is the elephant. . . ."

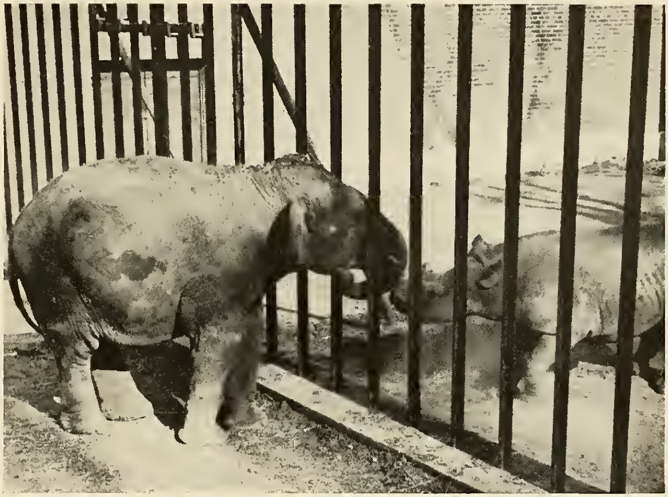
The "or so legend has it" brought to mind a scene I witnessed and photographed some years ago at the Brooklyn Zoo. The elephant and rhino had been standing "toe to toe" making threatening gestures at each other for some time. Finally, the elephant rushed the bars, brandishing his trunk. The rhino responded with a short charge that ended abruptly at the massive bars. The elephant took the round by turning quickly and smashing a left rear hook that shook the rhino, wedging his head between the bars.

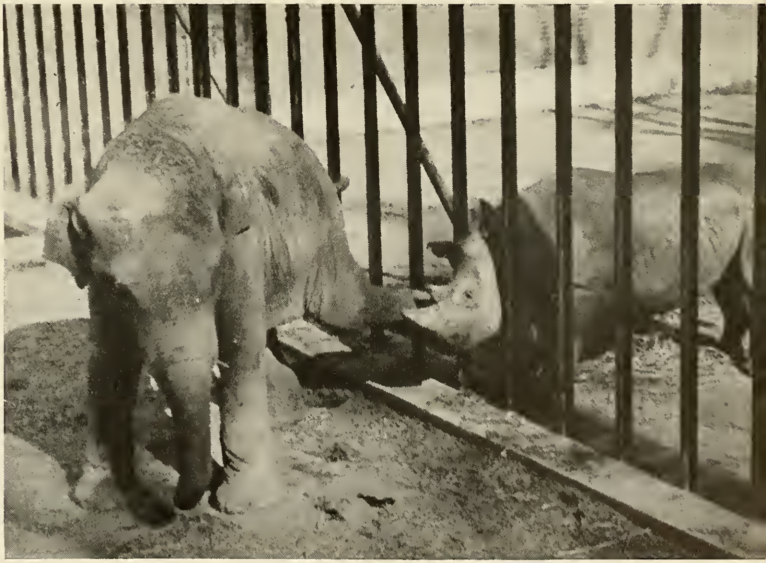
That seemed to take the fight out of the rhino. He withdrew his head, turned, and trotted off, snorting something to himself which I am sure would be unprintable if translated.

Murray Gordon

Bronx, N. Y.







Shy Turtles

Sirs:

This is to ask why turtles are so shy and fearful. I can't understand this when, as nearly as we have been able to observe during many summers at lake and stream, there is nothing except an occasional small boy that would threaten one of these animals. No creature on the Russian River is harder to approach. I have seen a half dozen or so flop hastily off a log when I quietly rounded a bend in the stream 100 yards or so away. Frogs and rabbits, both with many enemies, are far easier to approach. What teaches a turtle fear?

Max. L. Conner.

Alameda, Calif.

The following comments are offered by Mr. C. M. Bogert of the American Museum's Department of Reptiles and Amphibians:

The question of why turtles are so shy and fearful is not easy to answer. Some

NOTICE—Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on these pages will be paid for at $3.00 each, with full credit to the photographer. Return postage must be included.

kinds of aquatic turtles are more wary than others, but even within a single species they may differ from place to place. Innate behavior may be modified by conditioning. That is, a turtle belonging to a species that is ordinarily wary may become used to the presence of animals that appear on the horizon but do not disturb it. Even the shyest of turtles in zoological gardens eventually are quite undisturbed by the presence of people. But if every visitor attempted to climb into the zoo's enclosures to catch the reptiles, they might retain what was probably the normal impulse prior to capture and flop into the water as soon as a human head appeared over the railing.

It may safely be assumed that the turtles in the Russian River, presumably Pacific pond turtles (*Clemmys m. marmorata*), have other enemies aside from the small boys that pester them. Innumerable animals devour the eggs or recently hatched young of most turtles, but the protective armor of adults discourages attack by a good many enemies. Nonetheless, there are various carnivores, including raccoons, possibly otters, and alligators in the southern states that readily crack the shell or even engulf the whole turtle if it's not too large. Without making a careful survey in the region, it is doubtful whether an adequate guess could be made concerning possible predators in the Russian River—but they are almost certainly present.

It is noteworthy that on some islands where predators are scarce or nonexistent the close relatives of wary mainland forms are often quite easily approached. The whipsnakes on Clarion Island, for instance, can be approached by man and picked up with ease, whereas their relatives in Mexico and the American Southwest are among the more difficult snakes to capture. Habits may be modified in this way, either by environment or by selection, to produce the same result. It has been suggested, for example, that in most parts of the South, where the remaining alligators take to the water upon the approach of man, such extremely cautious behavior is the result of selection. This is to say that the wariest animals have survived to transmit to their offspring what is assumed to be a hereditary trait. Early travelers in Florida reported these large reptiles to be present in great abundance, with the rivers literally swarming with aggressive alligators that did not hesitate to attack men in canoes. Now most large 'gators flee to the deepest available water before a hopeful observer can get a good look at them. In places where they are not actually hunted, as at Silver Springs, an occasional large individual may be seen basking on the bank of the stream, and boatloads of tourists can be brought within 50 feet or so. Yet a truly aggressive alligator is not likely to be encountered.

As for those Russian River turtles, they are probably molested more often than casual observation might lead one to believe.

"Stop, Thief"

Sirs:

In Rocky Mountain National Park, Colo., I placed a peanut on a rock, hoping to get a picture of a ground squirrel. Just as I was getting in focus, a bird zoomed in from apparently nowhere, I shot, and when I developed the film I was very happy to see I had made the exposure at the exact moment when this Canada Jay or "Camp Robber" picked up the peanut.

Mrs. Thase Daniel

Norphlet, Ark.

History of the Siamese Trees

Sirs:

This morning I received my February issue of Natural History, and after marveling at the colors of the Pinguin on the cover, I turned the page only to see a picture which took me back 46 years, to be exact. I am referring to the letter from C. J. Bates with the picture of the natural graft between the two sycamore trees.

Before reading Mr. Bates' letter, I knew exactly where these trees were. I was born in Rutherford, and when I was about ten or twelve years old I lived within a half mile of these trees. I remember when they were separate. The limb of the larger tree, when I first noticed it, was wearing a hole in the smaller tree, and we could hear it rub when the wind blew. Then, as the limb grew, it imbedded itself in the smaller tree, making a solid connection. Apparently the chafing of the bark by each tree started the graft.

It may be possible that someone before my time, seeing that this limb was growing straight toward the smaller tree, purposely cut off the end of the limb in the hope that it would grow into the other tree, as it did. However, since the readers of Natural History are nature lovers, let's believe that this was entirely the work of Mother Nature!

Arthur E. Davids.

Hartsdale, N. Y.

Sirs:

Referring to the Siamese trees that one of your readers described in the February issue, may I say that in a place at the outer end of Penzance Peninsula, Woods Hole, Mass., there are a number of European beech trees (*Fagus sylvatica*) that have become almost a tangle of natural grafting.

Bassett Jones

New York, N. Y.

"Rain of Frogs"

Sirs:

My husband related to me an interesting phenomenon that he witnessed while returning to Clarkia, Idaho, on horseback. A cloud suddenly appeared, followed by a severe thunder and lightning shower. When he reached a draw, the rain had ceased and the sun was shining, but the

Continued on page 142

NATURAL HISTORY

The Magazine of the American Museum of Natural History

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VOLUME LIX—No. 3
MARCH, 1950

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You will find Natural History Magazine indexed in *Readers' Guide to Periodical Literature* in your library

THE COVER THIS MONTH

This happy Hopi Indian is Jimmy Kewanwytewa of Old Oraibi, Arizona. He is a familiar figure to those who visit the Museum of Northern Arizona, at Flagstaff, where Jimmy is official "Custodian." The costume you see is typical of the traditional Hopi man—colorful headband, Dutch haircut, work shirt, and dungarees.

Jimmy spends much of his time carving kachina dolls and has earned an enviable reputation in this art. These colorful wooden dolls represent the spirits of many different supernatural beings. They are sometimes carried in ceremonials and later given to the children so they will learn to know them. More than 200 different kachinas are included in the Hopi pantheon. The dolls are brightly painted and decorated with hawk feathers.

Jimmy makes most of his dolls for the Museum's own collection, but a few are sold to lucky collectors. On week ends you will find him back at his family home, high atop an isolated mesa in the middle of the Painted Desert. There he relaxes with his relatives and plans the kachina-carving he will do the next week.

Jack Breed

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The American Museum is open to the public every day in the year without charge

YOUR NEW BOOKS

Hopi Kachina Dolls • History of Science

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NEW WORLDS EMERGING

--------by Earl Parker Hanson

Duell, Sloan, and Pearce, $3.50
385 pp.

THIS is a readable and stimulating book, because its author is a stimulating and forceful man. He has seen much of the world and has given his best to help solve some of the problems that have arisen under a wide variety of human and environmental conditions.

Hanson's thesis is militant, but optimistic. Granting short shrift to racial prejudice and repression, he bets his purse on the underdog. He points out that "westward-ho!" has now run its global circuit and that civilization is busily turning at right angles into the traditional wastelands, *i.e.*, northward to the sub-Arctic and southward to the Amazon basin and similar areas. Now that man has more or less stopped insisting that these regions can't be occupied by people of high living standards and has begun to ask how best to bring it about, the end, writes Hanson, is assured. In his descriptions of the wide topographic and climatic variety within, for example, Alaska and Amazonia, and the resulting ecological niches for satisfactory human cultures, the author is reasonably convincing.

So far, so good. But it is hard to see why Hanson pooh-poohs such well authenticated, even if gloomy, pictures of man's plight as that in William Vogt's *Road to Survival*. Vogt surely learned his geography "in the field." In fact, Hanson to the contrary, there *is* no other kind of geographer.

Man has overbred in a large part of the terrain thus far found habitable. He has used up priceless resources nearly everywhere. Hanson completely ignores the fact that the destruction already stands up like a sore thumb in vast areas of South America and Africa, two of his pet continents. He plays up the African peanut project at a bad moment, because the current status of that grandiose plan augurs a fiasco.

Hanson's argument, indeed, falls frequently into traps of its own making. There is no parallel between the fifteenth century saving of Europe by the discovery of the New World and the "saving" of the modern horde of two billions (more tomorrow and mostly hungry) by the most intensive possible development of a residuum that is at least partly submarginal. The completely fascinating chapter on Iceland is a case in point. In all seriousness, it beats Horatio Alger, but Hanson is here dealing with a land of fewer than 200,000 people, a density of 3.3 to the square mile!

R. C. M.

I MARRIED A DINOSAUR

---------- by Lilian Brown

Dodd, Mead and Company, $3.00
268 pp., 18 photos

THIS is a bride's-eye view of a veteran fossil hunter. Lilian met Barnum Brown during a tour of India and married him there. Her book deals with the first two years of their marriage, spent in various parts of India and Burma.

Mrs. Brown relies a little heavily on the use of exaggerated slang, presumably for the sake of humor, but she does have the gift of natural writing, and many of her stories are genuinely funny. The descriptive passages are quite beautiful and reveal an excellent memory for details and impressions.

Very few women, I should imagine, could adapt themselves so cheerfully to camp life in a strange country. Lilian Brown describes as amusing several experiences that should have been, and perhaps were, rather terrifying. Her only complaint, throughout the book, is that her husband was too busy bone-hunting for them to have a real honeymoon.

Far from moping about it, she successfully occupied her time by making friends with the natives. Very wisely, she made no attempt to understand their way of life. She simply liked them, and they, her. In these days of suspicion and mistrust of any difference between peoples, such an approach is heart-warming.

In this account no dates are mentioned; this makes it difficult to place the book in time. This is a minor point, however, for the adventures of Lilian and Barnum Brown are so fresh and gay that they might have taken place only yesterday.

MARTHA R. BOGERT

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HOPI KACHINA DOLLS

----------by Harold S. Colton

University of New Mexico Press, $7.50
20 figs., 8 in color; numerous line drawings

NEARLY every traveler to the southwestern United States—particularly if he is interested in the present-day Indian population—is familiar with the kachina dolls manufactured in the Hopi villages of northeastern Arizona. Perhaps he has acquired one of these engaging wood carvings and is curious to know its history and what it is intended to represent. It is to such an audience that the present handsome and informative volume is directed. It should in addition prove useful to the serious student of the American Indian.

To the Hopi Indian the term "kachina" is employed in three different contexts: first to mean a supernatural being, second to designate a masked dancer who, during certain ceremonies, impersonates this spirit. Thirdly, kachina refers to the small painted wooden effigies that represent both the supernaturals and their masked impersonators. After the ceremony for which they are made, these dolls are given to the children, not as mere toys, but as a part of the youngsters' religious training. Kachina dolls, therefore, are neither idols nor ikons but only objects used in the education of the Hopi child.

Since the Hopi recognize over 200 kachinas and frequently invent new ones, the problem of identifying any particular supernatural is complex. The Hopi art style, moreover, is extremely stylized and symbolic, so that the identity of a given kachina must be determined from details of the mask, body painting, ornaments, accessory objects, and the like. The two longest sections of the book are devoted to careful descriptions of the various kachina dolls and to a convenient key designed to assist in their identification. Both of these sections are abundantly illustrated with schematic ink drawings. There are in addition excellent photographic plates, eight of which are reproduced in full color. These latter happen to be the work of Jack Breed, who photographed the scene reproduced on the cover of this issue of NATURAL HISTORY.

HARRY TSCHOPIK, JR.

AN ILLUSTRATED KEY TO THE LIZARDS, SNAKES, AND TURTLES OF THE WEST

by Jay M. Savage

Naturegraph Co., Los Altos, Calif., 50c
32 pp., illustrated

THOSE who want to make field identifications of the reptiles found west of the Rocky Mountains will welcome this 32-page pamphlet. It is small enough to be tucked into a shirt pocket and yet ample for the intended purpose, even to the inclusion of reasonably accurate distributional maps.

C. M. B.

THE QUAILS

by Edward S. Spaulding

The Macmillan Co., $6.50
123 pp., 7 color plates

THE scope of this volume is more restricted than the title would indicate. Aside from a chapter on the introduced Hungarian and chukar partridges, the author limits himself to the six or seven kinds of quail found in the United States. Of these, the best known is the eastern bobwhite, but all its handsome crested relatives are natives of the Southwest. Fortunately, Mr. Spaulding is a Californian, and he has made the most of his opportunities to study these engaging birds at all seasons and under all conditions. His informal accounts of their habits, though written as a sportsman, reflect a mature appreciation of nature and an enlightened approach to such controversial matters as predator control. Of the almost mythical masked bobwhite, long extinct in the United States and nearly so in Mexico, he of necessity speaks in general terms, but the chapter on the elusive and bizarre Montezuma quail contains much valuable, hard-won information.

The seven colored plates are the work of Francis Lee Jaques. Although the details are not always beyond criticism, these paintings possess striking beauty and will insure for the volume a somewhat wider audience than that provided by the sportsmen to whom it is primarily directed. For reasons undivulged, the elegant quail, a Mexican species scarcely mentioned in the text, was selected for the frontispiece.

Dean Amadon

A SHORT HISTORY OF SCIENCE AND SCIENTIFIC THOUGHT

by F. Sherwood Taylor

W. W. Norton and Company, $5.00
368 pp., 28 plates, 53 figs.

THE author is the Curator of the Museum of History of Science at Oxford, and now science would appear to have, by title at least, a qualified historian. This short history covers a vast spread in scientific thought, ranging from the work of early Babylonian and Egyptian scientists to that of the scientific thinkers of today. There is a general running history of science, but certain concepts are treated in more detail, such as developments in the fields of chemistry and nuclear physics. Taylor thus attempts to show the dependence of today's science upon scientific thinking of the past. In general, the book is coherent and logical in its progression through time, and a generous sprinkling of illustrations serves to enlighten the reader. Included are many original drawings and diagrams of the scientific discoveries of the past. Four of the chapters give the reader a brief but informative history of the steps leading to the atom sciences of today.

A dynamic quality is given to this history by the inclusion of a series of short but well-selected readings from the great scientists from the Babylonians to Einstein. These selections help to orient the reader and give the flavor of scientific thought in the several eras of science discussed, which would be difficult to impart if done only in the words of a twentieth century historian.

It is only in the last chapter that the author becomes noticeably subjective and indicates his alarm over the path the world seems to be taking. He strongly expresses the opinion that it is high time that the men of science become ethical as did the men of medicine. Science is a tool, but the author realizes the power of the tool and thereby the power of the men who wield the tool. Taylor questions whether scientists will try to control their science. He does not answer this question but pleads for watchfulness in these significant times.

John R. Saunders

ALLEN LATHAM'S BEE BOOK

by Allen Latham

Hale Publishing Co., Hapeville, Ga., $2.95
200 pp., 3 illusts.

THE incorporation of the author's name into the title of this book is appropriate, for after 65 years devoted enthusiastically to the keeping and observation of bees, a person presumably has yoked his personality so completely with the object of his interest that they form a complementary whole. The title has equal validity because the author inclines to be heterodox in his interpretations, and even his observations are often rather at variance with those of other investigators. Thus it is well to know from the start that the book is in large part a given individual's experience rather than a weighted summary of the conclusions of others.

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The book will have special interest for fellow apiarists, who have faced problems of much the same character as those with which the author was confronted in the course of his long career. For many of these problems he found happy solutions. His interpretations of bee behavior are often stimulating, even if at times unusual.

One could wish he had taken more cognizance of the work of others, particularly in those cases where his own observations are at variance with theirs. His timetable of the successive functions—nursing, building, foraging, and the like—of the individual bee does not coincide with that of an investigator like Rösch; and his statement that bees follow the discoverer of a source of nectar takes too little cognizance of the conclusion reached by von Frisch, on the basis of painstaking experiments, that the character of the "dance" executed by the discoverer of the nectar reports the location with sufficient accuracy to dispense with the necessity of having the discoverer lead the way to the nectar supply.

The book has its defects. But as a personal record of an interested and enterprising apiarist with a healthy curiosity regarding his bees and their relatives (in which he includes the rather too remote termites), it is to be commended.

Herbert F. Schwarz

THE SAGA OF THE WATERFOWL

by Martin Bovey
Cover and title page designs
by F. L. Jaques

Wildlife Management Institute, $5.00
141 pp.

THRONGS of waterfowl once inhabited the vast marshes and innumerable prairie sloughs of North America. A slow decline in their numbers began almost with the arrival of the first western pioneers. Marshes were drained and spring shooting decimated the birds as they attempted to nest, while commercial hunters slaughtered them on Chesapeake Bay and other winter concentration areas. The abolition of market gunning, along with other protective measures, slowed but did not halt this decrease, for the destruction of habitat continued apace. Then, in the late 1920's, a series of dry years added their disastrous impact. The Dust Bowl appeared, and though its human casualties made their hazardous escape to California or other havens, nesting waterfowl

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were doomed. Belatedly aroused private and public agencies strove to improve matters by tightening game laws and by restoring marshlands. The results have been as good, perhaps, as could be expected, but the ever-increasing army of sportsmen and the ceaseless demands of agriculture make the future of our ducks and geese a precarious one.

This *Saga of the Waterfowl* is here depicted in a series of dramatic photographs. The text is merely a terse, running commentary that averages only two or three lines per page. Mr. Bovey's photographs are not waterfowl portraits; rather they are panoramic views of marshes and destroyed marshes, of duck hunters and would-be duck hunters who find their sport has vanished. When birds are present, they often are little more than silhouettes against sky or water.

Let us hope that this graphic plea for conservation will help us realize that wise management of marshlands and water resources is of crucial importance not merely to waterfowl but to man himself.

Dean Amadon

GAME FISH OF THE WORLD

- - Edited by Brian Vesey-Fitzgerald and Francesca LaMonte

Harper and Bros., $15.00
446 pp., 80 illusts.

THIS book, an authoritative and interesting treatise, is a compilation of contributions from well-known and widely recognized sports fishermen, including Major K. Dawson, Dan Holland, Lou S. Caine, Ollie Rodman, Philip Wylie, George C. Thomas, III, William W. Lovett, Jr., S. Kip Farrington, Jr., Ernest Hemingway, Michael Lerner, Van Campen Heilner, Leander J. McCormick, H. D. Turing, Norman L. Weatherall, N. K. Robertson, T. C. Roughley, Dr. Henry Gillet, W. W. Small, and Lt. Col. R. B. Phayre. More than 100 species of game fishes are shown in outstanding color plates by Dr. A. Fraser-Brunner.

Each contributor to *Game Fish of the World* was especially selected because of his knowledge of the subject on which he wrote and of the area or territory in which the fish under discussion lives. The result, combined with an excellent piece of editing, is a series of articles that are little short of amazing in their detailed coverage —something that all anglers can either read with pleasure or study with interest.

Game Fish of the World is divided into six parts, the first of which contains a thorough exposition on salmon. Part 2 takes in the favorite game fishes of North and South America, while Part 3 has the game and coarse fishes of Great Britain and Ireland as its subject. Australian game fishing is treated in Part 4, African game fishing in Part 5, and the game fishing of India in the last part of the book.

This one volume contains a variegated knowledge of the world's most highly-prized game fishes, knowledge that took each contributor many years of application and many thousands of dollars to learn. This information, thoroughly up-to-date, is now passed on so that other anglers may have the benefit of wide fishing experiences. Many gamesters that most anglers have heard of only vaguely are pictured in color, and the book will serve as an introduction to these gamesters.

In addition to these fine color likenesses, this introduction is complete with word pictures written by anglers who somehow manage to carry the reader along with them on the fishing trips they so vividly describe. Thus the angler is enabled, sitting comfortably by his fireside, to visit and fish (in effect) in such places as Alaska, Spain, the British Isles, Australia, New Zealand, South America, Africa, and India. It truly opens to the angler a piscatorial vista heretofore denied him, or enables him to relive the experiences of his own fishing trips to near and faraway localities.

In conclusion, we would unhesitatingly express the opinion that *Game Fish of the World* is perhaps the most useful volume on game fishing that has ever been presented to the angling public. That it deserves a special niche on the bookshelf of every angler goes without saying.

Erl Roman

NORTH AMERICAN FRESH WATER SPORT FISH

- - - - - - - - - by Lou S. Caine

A. S. Barnes & Company, $5.00
212 pp., 91 illusts.

THIS book is by one of the most unassuming, competent, and popular anglers in North America and is a thoroughly reliable job. The sections headed "Biological Facts" were written by Dr. Karl F. Lagler, an ichthyologist already well known to anglers as one of the coauthors of "Fishes of the Great Lakes Region," by Hubbs and Lagler.

The method of handling such material has become almost standard, but here there are several valuable additions. As usual, the fishes are arranged in their correct groups, headed by a short general discussion of the group as a whole. The individual fish is then taken up under various standard headings: name, scientific name, range, habitat, color, size, food, distinguishing characteristics, and a section called "biological facts" which deals chiefly with spawning habits and growth rate. To these more usual sections there have been added paragraphs on fishes as food and as game, and on artificial lures, and fishing methods. The most valuable addition of all, however, is the inclusion of a line cut for almost every species, illustrating the outstanding external peculiarities [or] distinguishing characters of the fish in question. These cuts are large and very clear and should be of great use to the angler in identifying his catch. The black and white illustrations and color plates are excellent.

At the end of the section on fishes, there are well-illustrated and clearly written sections on tackle and methods. These are followed by a reading list for anglers and an index.

This book has been prepared in a careful, orderly, and attractive way by a man who knows a great deal about fishes and everything about how to catch them.

F. LaMonte

THE SANDHILL CRANES

- - by Lawrence H. Walkinshaw

Cranbrook Institute of Sciences,
Bloomfield Hills, Mich.
202 pp., 5 maps, 18 pp. of illusts.

ONLY two species of cranes inhabit North America, but these stately birds have an importance for the naturalist beyond what mere numbers might suggest. Although the great white whooping crane is now nearly extinct, the brown sandhill crane is still found in many parts of the continent. For the past fifteen years, Dr. Walkinshaw, the author of this volume, has devoted the spare moments snatched from a busy professional life to an intensive study of the sandhill crane. His quest has taken him from the tundra of Alaska to the palm-dotted savannas of the Isle of Pines, accompanied at times by a pet crane, reared in captivity to throw further light on the behavior and development of this species. Zoos, museums, and libraries were also visited in his search for information.

The present volume, crammed with facts and supplemented with tables, bibliographies, and a key to the cranes of the world, is the result of this concentrated effort. Ecology, life history, migration, and conservation all receive detailed treatment. A book to be valued for either reference or enjoyment, it is a model of what an amateur ornithologist can accomplish by a carefully planned program.

Like other Cranbrook Institute publications, this book is well made. The cover design depicts a crane with neck upstretched watching three others in flight, while a beautiful Kodachrome of a sandhill crane taken in Alberta by B. W. Baker serves as a frontispiece. Of even greater value are 33 black and white photographs of cranes and their nests and eggs taken in all parts of the range.

Dean Amadon

A TRAVELER'S GUIDE TO ROADSIDE WILD FLOWERS, SHRUBS AND TREES OF THE U. S.

- - - - - Kathryn S. Taylor, Editor

Farrar, Straus & Co., $3.00
182 pp., 4 color illusts., numerous drawings

BOTANICAL publication has finally entered the automobile age in this streamlined little book, replete with reciprocating machinery that seems to work. Arranged according to color is a list of 743 species of trees, shrubs, and herbaceous plants, each with a few descriptive words and many with marginal thumbnail illustrations. The accompanying locality abbreviations are geared to three maps of the United States that show state boundaries and the major landform areas.

Part 2 is an alphabetical arrangement of states, each with an outline map and with such accessories as the best automobile routes and a picture of the state flower. The reader of the book travels along, and according to season sees by the roadside "drifts of sky-blue lupine" or "shrubby cinquefoil" or "dwarf iris" or "Scotch broom," depending upon the state in which he is traveling. Then he notes the catalogue number and turns back to the systematic list in Part 1 to find the scientific name and family and general distribution of the plant under observation, or one very closely related. This arrangement saves space and eliminates much of the difficulty with common names, which often vary from state to state. Then there are listed "Centers of Interest" for our botanical tourist, such as museums, national parks, experimental farms, etc. The mechanism seems to have been checked pretty well for the identity of material to be included. There is a good bibliography. It occurs to me that the list might have included *Southern Wild Flowers and Trees* by Alice Lounsberry which though published in 1901, does not seem to have been surpassed for this region.

H. K. Svenson

THE LIFE OF AUDUBON

- - - - - - - - - - - - by Clyde Fisher

Harper and Brothers, $2.50
76 pp., 20 plates, 53 figs.

THERE have been other more detailed biographies of this great painter-naturalist, whose plates adorn the walls of so many American homes. Yet this short life story, with pictures from the collection of the American Museum, will fill a definite need. Few men could better appreciate John James Audubon than our own Clyde Fisher, whose life was devoted to imparting enthusiasm for the study of nature and of our universe.

Audubon's life was nothing if not dramatic. Coming to Pennsylvania in his late 'teens, he was followed by rumors that he might be the lost Dauphin of France. The drawing of birds was his greatest interest. But he was expected to earn his living and so became a merchant in Kentucky. He had a loving wife, too, and soon there were two sons. His heart was not in business however; in another twelve years he was bankrupt.

At this point he found employment at the Western Museum in Cincinnati and decided to publish his collection of bird paintings. Many gaps remained to be filled; he started for Louisiana. "Without any money," he wrote in his diary of 1820, "my talents are to be my support and my enthusiasm my guide in my difficulties."

Before he could secure subscriptions to his "Birds of America," to be published in double elephant folio, he must visit Great Britain. For 20 years he traveled, hunted, painted, and edited; he proved himself by far the greatest salesman of natural history publications in his day.

That huge task completed, he settled in New York and soon was off again to the upper Missouri. The "Quadrupeds" were still to be done, but that work was only completed by his sons. Naturalists are apt to rate Audubon higher as a zoologist than as a painter. The artists extol him as one of their own. No doubt both sides are right.

James P. Chapin.

THE HISTORY OF NATURE

- - - - - By C. F. von Weizsäcker

University of Chicago Press, $3.00
191 pp., 8 illusts.

IT is no accident that the men who are most profoundly disturbed by the implications of our rapidly expanding science are frequently to be found in the ranks of physics where they come closer, perhaps, than any other group of scientists to the terrifying aspects of massive power over nature and mankind. It was possible, Dr. von Weizsäcker says, for scientists of an earlier age to ignore the responsibility

Continued on page 142

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MISSION: *Malaria*

By HARRY HOOGSTRAAL

Field Research Associate, Chicago Natural History Museum

THE United States Navy has seldom sent a mission on stranger sea duty than it did in 1948 when the Naval Medical Science Group, accompanying the University of California African Expedition, fought its heavy trucks through the thick sands of the Libyan and Nubian deserts and into the Sudan to find and domesticate elephant shrews infected with malaria.

An earlier report of malarial infection in a shrew in the Sudan suggested to Dr. Clay G. Huff, of the Naval Medical Research Institute in Bethesda, Maryland, the advisability of attempting to find and isolate such a parasite. If a small mammal naturally infected with malaria could be adapted for laboratory use, it would be a great boon to research on this disease about which we still have so much to learn. A large part of malaria research must of necessity be done on animals, and birds have been the most convenient subjects. But because man is a mammal, studies of the disease in another mammal would be much more conclusive and directly applicable. It has been brought to light in recent years that part of the life cycle of malaria occurs in fixed tissues of the host, in addition to the well-known phase in the blood. This has made the demand for an experimental mammal even greater than heretofore.

So when my old friend Commander Kenneth L. Knight phoned by long distance and told me I would naturally want to join the naval group in Africa for the purpose of ferreting out this and other animal diseases, it was impossible to refuse. True, I was thoroughly enjoying the wonders of America after having just returned from three years in the Pacific. But my spirit of adventure rose as I contemplated the fascination of visiting more strange places and of hunting animals and diseases that research scientists have been waiting for years to see and study.

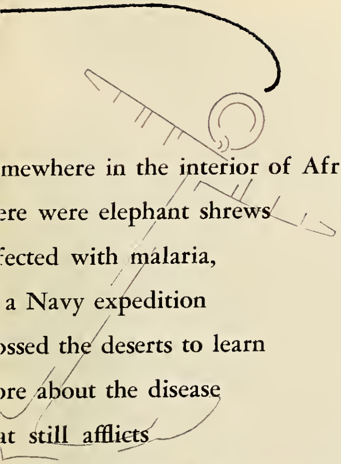
The informality of expedition life, the association with people in all stages of civilization and levels of society, the thrills of solving a varied assortment of problems, and the never-a-dull-moment atmosphere of the work, outweigh, in my opinion, not a few of the advantages and comforts that are to be found in the fast and troubled tempo of more civilized parts of the world.

To reach the land of the elephant shrew, near the southern border of the vast Sudan and eastward toward the wilds of Abyssinia, we headed our trucks southward from Port Said through the fertile Nile Valley, with its centuries-old water wheels, millions of domestic animals, and cluttered villages. At Assuan, in southern Egypt, the desert "track" began.

For about ten days we followed

Official U. S. Navy photo

▲ LINKS in the exploratory chain. *Left to right:* Chief Deaner K. Lawless, Medical Research Assistant, U.S.N., who worked with the author; William Terry, University of California representative; Captain J. J. Sapero (M.C.), U.S.N., who assigned the party to the project. *Standing:* Commander T. K. Ruebush (M.S.), Naval parasitologist, and Dr. C. G. Huff, Malarialogist of the Naval Medical Research Institute, who initiated the undertaking



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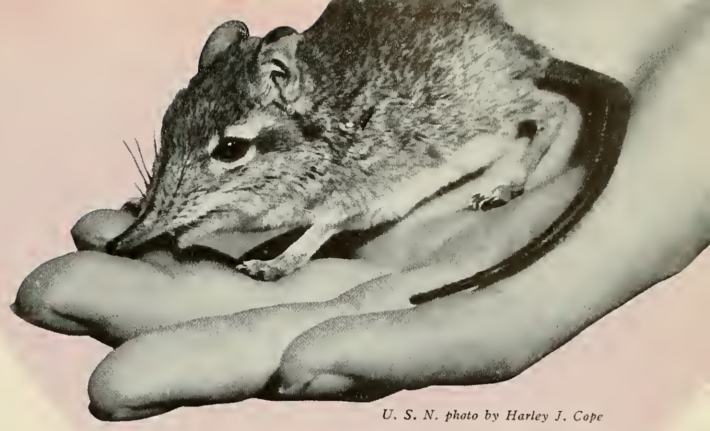
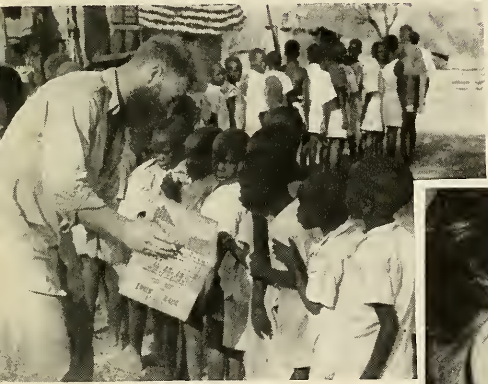


U. S. N. photo by Harley J. Cope

▲ **The object of the quest**: the elusive elephant shrew, sought in the hope that this small mammal would shed light on human malaria



U. S. Marine photo by Charles Evans

◀ **Richard Alison** showing the captive shrew to school children at Kapoeta so they would know what to look for. Soon they were bringing in dozens of them

▼ **Stroking** under the chin makes the elephant shrew's mouth water. Then the animal is easily "hypnotized" and will remain motionless for a considerable time

Harry Hoogstraal photo

a vague camel trail or only the intuition of our Arab guide. Though we traveled slowly, we still had to stop sometimes while our guide scanned the vista of peaks and hills for his familiar landmarks. More often, however, we were halted when our heavy trucks floundered in soft sand and had to be winched out by lighter and more mobile trucks.

There is little variety over this great expanse of desert but rather a magnificent monotony that, like fire or running water, compels one to look and look. Now as our party looks back on the year in Africa, we all agree that the days in the desert held our interest as much as anything we saw on the whole continent.

U. S. N. photo by Harley J. Cope

▲ **Headquarters** at Kapoeta. The author is showing the shrew to Commander J. M. Amberson, while Chief D. K. Lawless peers through the microscope at elephant shrew malaria

Even more than 25 miles from the nearest twig of vegetation a rare snake slithered from under a rock when disturbed, scorpions assumed their familiar offensive attitude, silverfish scurried away from their little piles of wind-blown debris, and praying mantises, curiously adapted for life in sand, raised their forelegs as they do the world over.

Scores of bleached camel bones along the track testified to the difficulty of the march, as did a human skeleton that our chaplain stumbled upon one day as he walked out to pray.

One day, our physicist was explaining how mirages are produced, when we noticed an unusual movement on the border of one of the lakes-that-were-not-there. Soon we were abreast of an advancing camel train of about 100 animals and a dozen men. Another night we were awakened from our bedding roll by the sounds of a camel train, wonderfully silhouetted against the cold, bright desert moon, shuffling through the sand and being urged onward by the low, steady chucking and calling of the drivers.

When we turned toward the Nile, where the hand of man has disturbed the serenity of the desert, the landscape lost much of its quiet splendor.

At Wadi-Halfa, the busy, sunbaked river town on the border of the Sudan, we paused to do a bit of medical investigating and mammal collecting. Then onward across hundreds of miles of desert, southward through the Sudan.

Just before Er Renk, about 300 miles south of Khartum, we left the country of the white-shrouded Arab and were startled to find ourselves abruptly among tall, thin, naked Negroes. During our next several months among these Nilotic tribes of the Sudan, we never ceased to admire them. Proud, primitive, sturdy, superstitious, honest, completely naked, and heavily ornamented, these Nilotics have been forced by the British to abandon most of their fierce intertribal warfare and to do some cultivating of the land; but otherwise, for the most part, they continue to live as they have for centuries past.

In the midst of this hardly tamed country lives the elephant shrew. A lucky clue dropped at Khartum during a conversation between Commander J. M. Amberson, who was in charge of our group, and an American missionary indicated that at Kapoeta in southeastern Sudan, these snouted little animals could often be seen running about in broad daylight. If we hurried we could skirt the tremendous morass of the Nile sudd just before the rains closed the packed mud road for many months to come.

At Juba, the last British installation in the southern Sudan, Commander T. K. Ruebush, Naval parasitologist, found so many important medical problems that he was regretfully forced to turn the elephant shrew project over to his assistant, Chief Deaner K. Lawless, Medical Research Assistant, USN. Chief Lawless entered eagerly into the work, and once at Kapoeta, we were soon spending sleepless nights searching for the pot of gold at the end of the rainbow—elephant shrew malaria.

At first we failed to get even a smell of what we had come for. Richard Alison, my bushy-bearded New Zealand soldier-of-fortune assistant, and I placed dozens of traps

▲ **Chief Deaner K. Lawless buying elephant shrews from Taposa men at Kapoeta**

Harry Hoogstraal photos

in the likeliest spots. All we caught in them were rough-haired grass rats and tiny, beady-eyed true shrews. Then, at last, a sick, maimed elephant shrew crawled into one of our traps one night to find a place of refuge.

The poor animal had little peace after we discovered it, for we collected everyone in camp to see the little beast that had lured us so far off the beaten path. In a moment we had a drop of its blood on a glass slide. It was stained, waved in the air to dry, and placed under the microscope. After the first quick look, everyone knew that we had found what we were looking for. Indeed, our first elephant shrew had the heaviest density of malarial parasites that we were to find in hundreds of animals examined during the next few months!

A day or two later, Major R. M. Allott, the commander of the local Sudan Defence Force base and the only Britisher for miles around, returned to Kapoeta and, being apprised of our need for large quantities of elephant shrews, took hasty action. Summoning the prisoners, the soldiers' children, and the native population, he had Alison parade the cage containing our prize elephant shrew up and down the lines of people, tell them what the reward was for each living specimen, and chase them off to capture more.

The elephant shrew that the people had seen in the cage was a reddish-brown, thick-furred little animal, some eight inches in length, about half of which was almost naked tail. Its hind legs were elongated like those of a rabbit, its forelegs reduced in length. The large, dark eyes, specialized for night vision, were offset by a conspicuous circle of white hairs. Most interesting of all was the long, pointed,

▼ **A familiar scene in the field laboratory: microscopic examination of elephant shrew blood**

grooved snout, which the creature moved actively up and down when excited or investigating food.

The elephant shrew appears to most people to be a strange kind of rat. It is not a rodent, however, but an insectivore. Thus it belongs to the most primitive of mammal orders, the same one as the hedgehogs. The species with which we are dealing has recently been identified as *Elephantulus rufescens rufescens.* About 30 forms of the genus are found in Africa and Asia Minor but nowhere else. They range from Algeria to the Cape, but we believe that our species is the most northerly one in East Africa. A few elephant shrews in other families and genera grow almost to the size of half-grown rabbits!

Elephant shrews were seen easily enough at Kapoeta in April, for the clump grass was burned to short, blackened stubble. The rains that cause it to grow taller than a man had scarcely started. Now only low tree or bush acacias and thick clumps of a cactus-like euphorbia grew in the heavy clay "cotton soil." The little animals liked to hide under these or under the highly protective fences which the Taposa make by throwing up the spiny branches around an area they intend to cultivate during the rainy season.

We often saw the animals in the morning and in late afternoon but only seldom during the heat of the day. They were difficult to detect when motionless but were easily startled into running when a person approached. They hated to leave their runways, but if desperate to escape they often disappeared into the long, deep fissures that broke the earth during the dry season.

Groups of four or five Taposa men or boys were able to harry the elephant shrews into a senseless flight that ended in the cupped hands of one of them, and so our first lot of research animals was accumulated. Men earned a week's wages in a few hours; but the British were not disturbed, for they said the situation was so temporary and unusual that it would hardly upset the economy of the tribe.

The Nilotic tribes, most of whom refer to the elephant shrew as *ikabok,* say that they come into their huts at night and that they eat rats. The former story may be true, but with their small teeth and weak jaws we find it impossible to believe the latter one. The natives also consistently say that the animals disappear during the rainy season, but this is undoubtedly an assumption based on the difficulty of seeing such small creatures in the thick grass.

At Torit, about 100 miles west of Kapoeta and about 80 miles east of the Nile, we found a different tribe of Nilotics, the Lotuka. And here we encountered the elephant shrew under very different circumstances. After searching in vain under acacia trees in the grassland, we went farther away from the settlement where there were few if any single trees in the grass. There groups of several trees of different kinds formed dense islands of vegetation. Below the trees were vines and shrubs and a few succulent and herbaceous plants. Outside in the uniform grassland the sun was hot and glaring, but inside the islands of vegetation the temperature was several degrees cooler, and there was little light. Each island might measure from 10 to 30 feet in width and from 30 to 70 feet in length. In these shady refuges we found the elephant shrews.

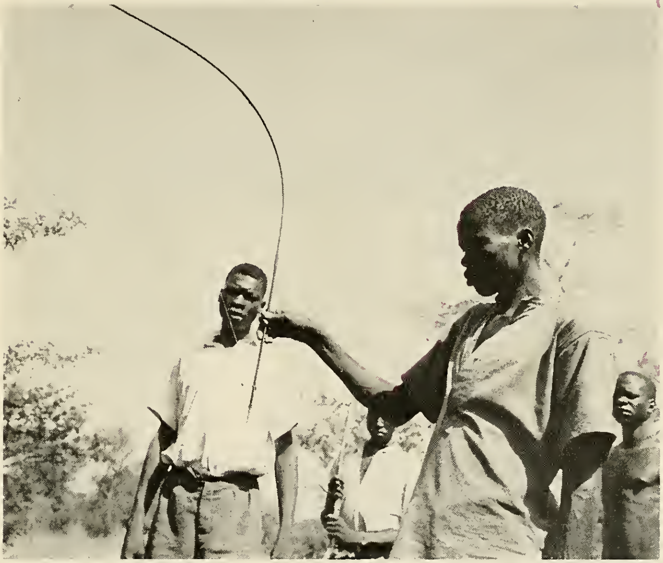
After we had visited a considerable number of these islands, I came to the conclusion that the islands had been able to establish themselves in the dense grass because of the large termite mounds that dotted the area. When the termite mounds are in active operation, no plant can grow on their hard, sun-baked sides. But when successive rains beat down abandoned mounds, their consistency changes and seeds that fall on them germinate and develop into plants. The chemical characteristics of the soil on these mounds is apparently more favorable for tree and shrub seedlings than for grass, and gradually, as the first intruders grow and produce shade, others are able to gain a foothold. Thus the islet becomes an ever-growing island of dense, heterogeneous vegetation.

The elephant shrew runways in these islands were eagerly pointed out by the Lotuka guides, who had been assigned to us by the Torit District Commissioner, Mr. John Owen. Each of the dozen men and boys carried his own equipment for catching these animals. It consisted of several small bows but no arrows to shoot from them. Instead, they bent each bow into an arc and tied the sagging string into an ingenious noose about two inches from one end.

When all the bows in the party had been so prepared, the men chose one end of a large island of vegetation that showed a number of fresh runways. In each narrow path they thrust several bows upright so that the noose was just above ground level. Now that every pathway was covered, they retreated to the outside of the island and started shouting, throwing stones, and beating the vegetation with sticks. Scared by all the commotion, the shrews fled down their familiar runways and trapped themselves as they reached the nooses. About half of them were instantly killed, but the others were unharmed, and these we placed in cages.

This method of obtaining live specimens worked quite nicely at Torit during the dry season, but when we needed more during the rainy season, we ran into serious difficulties. Our quarry was seldom where we had come to expect it to be. The animals took advantage of the shade and concealment offered by the grass that had sprung up so densely with the rains, and left their dry-season haunts to roam far and wide. Added to this, we had difficulty in getting enough Lotukas to accept the time-consuming job at this season. Normally they divide their activities, hunting during the dry season and cultivating their millet fields and caring for their goat herds during the wet season. As it is, the District Commissioner has to force them to cultivate by sending police and soldiers into the village, and we could hardly assume the blame for subsequent starvation by interfering with his program. So we assembled the few available men

◂ A FAR CRY from the clinical laboratory: natives and their policeman-boss setting out to catch the little animals near Torit



▾ THE BOW AND NOOSE devised by the natives for catching the shrews as they fled down their familiar runways

Harry Hoogstraal photos

and boys, obviously not the most experienced, and offered them huge bonuses. We taxied them to and from the hunting grounds and helped them as much as we could; but the results were always disappointing. Our own live traps yielded nothing but grass rats. At last we were forced to load cages on porters and obtain our animals from a more distant village where the grass was shorter.

That is the story of the capture of the elephant shrew. But the laboratory aspect of our project and the domestication of the animals are another story.

Lawless and I had to find out as much as we could about the malaria that we found in the animals and try to adapt them to cage conditions. One of our first jobs was to determine what they ate and to provide a suitable diet that could be easily and inexpensively offered them in the laboratory.

We found by stomach examinations and feeding experiments that termites and some kinds of ants were their favorite food, though they did eat some other insects and a small bit of vegetable matter. They could not cope with large grasshoppers, and the shells of some beetles were too hard for them to crush. Other insects must have had an offensive

William Terry photo

◂ THE AUTHOR showing a native how to hold the shrew when transferring it from the noose to the cage

Harry Hoogstraal photo

▲ COLLECTING mosquito larvae in tree holes near Torit: Chief Deaner K. Lawless searching for the insect that carries elephant shrew malaria

odor, for they, too, were disdained.

If wingless termites are their "meat and potatoes," fat winged termites are to the elephant shrew what ice cream is to the American child. Whenever the winged termites left their nests, a feast day was proclaimed, for they are also much relished by the Nilotics. The natives have two clever ways of obtaining them. Rain induces the winged members of the colony to fly out, and so the natives imitate the patter of rain by tapping on the side of the termite mound. To make sure of the illusion, they pour a few drops of water down the opening. Then the termites fairly gush forth and are easily collected. Or when natural rain induces the termites to leave, the Nilotics build a fire over a pit dug near the mounds. The termites, attracted by the light of the fire, fall through the flames into the pit and are scooped up to be eaten or sold to the less industrious natives—or to us as elephant shrew food.

Other insects were extremely rare during the dry season at Kapoeta, and we had to depend almost entirely on termites. Large termite nests dotted the landscape, but the inhabitants, living in considerable self-made heat underground, were seldom near the surface or openings, and the sun-baked walls of their castles were most difficult to break into. Another termite, which makes a small domed mound lined with cut grass stems, was more readily obtainable, but we quickly consumed the local colonies.

When quantities of worker and soldier termites or ants were placed in the elephant shrew cages, so many of the insects attacked the animals and attached to their feet, tails, and ears that they cowered in the corner in fright. Wanting to get them started on an artificial diet anyway, we began giving them chopped meat—whereupon almost all died.

It was difficult to fight off depression as—without elephant shrews—we struggled back to Juba over rain-soaked roads in our jeep. After the first day with the rest of the party, our spirits revived, and we blatantly announced that we were sure we could keep the animals alive if given half a chance. After deliberation, the Commander, always a good sport for a challenge, told us to go ahead and try our luck. He headed down to Kenya with his party.

Our second attempt was a complete success. This time we set up operations in two *tukals* (small native-type huts) in the yard of the Juba Hotel and brought our catch in from Torit. Jock Graham, the generous Scotch manager of the hotel, loaned us his carpenter for making cages. He also provided the various foods that we offered the animals in our attempt to determine their preferences, and he helped us in many other ways.

Small children with bug-nets could be seen all over the Juba landscape as they chased the plentiful grasshoppers for our elephant shrews. But we were still anxious to get our charges started on a diet that would be practical under laboratory conditions. Graham gave us small wax-paper dishes, and after some experimentation, each shrew was fed nightly with a dish of oatmeal and milk, chopped meat, chopped eggs, and a "come-on" of live grasshoppers. This is the same diet that later was fed them in the States, except that meal worms were substituted for grasshoppers and termites.

We fed newly-captured animals with milk from a medicine dropper. All but a few were eager to accept this strange food, but they showed little interest in dishes of milk in their cage until taught to drink. We would hold one with its snout almost in the dish and force the dropper into its mouth. As it drank we would slowly withdraw the tube into the dish of milk. The animal would then lick the sides, and finally the milk, from the dish. We felt that they needed this sustenance during the initial period when they were eating but little.

However, we were concerned over the radical departure from their

➤ NATIVE, elephant shrew, and Gladys Terry, wife of Administrative Director, University of California Navy African Expedition usual diet. Obviously they ingest no liquids during the long dry part of the year when little if any dew falls. The few stream courses are completely dry during this season, and rivers are many miles away. We suspected that some animals that died with distended bladders were adversely affected by the milk, but before we could prove this point one way or the other, they began accepting their new diet and our worries were over.

Chopped meat was always quickly accepted, but some individuals ate chopped eggs while others refused them. None displayed an interest in dry rice, peas, or lentils, though the natives insisted that they did eat grass seeds.

We noted that they refused to eat any food until they had touched and sniffed it with the tip of their long snout. Once they had decided the food was palatable, they might hold it down with one or both forelegs. The head of an insect was always eaten first, then the thorax, and lastly the abdomen.

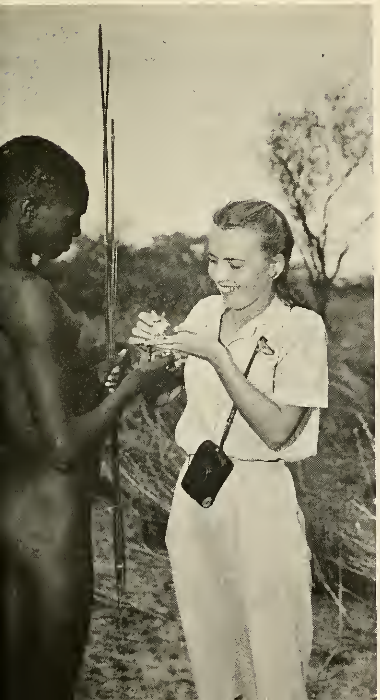
The elephant shrew is a slow eater and often rests between mouthfuls. But a meal of winged termites was an exception: they were always eaten without a pause. Cage partners often fought over a grasshopper that one was eating, even though several other grasshoppers were only an inch or two away. The males were usually the aggressors in these fights, but a few females dominated their mates similarly. During the daytime they were clumsy about catching grasshoppers in their cages, and several attempts were usually necessary.

Housing our little beasts became a project out of all proportion to their size. It had been impossible to carry cages on the long trek to the Sudan, and materials for their construction were scarce, to put it mildly. Southern Sudanese carpenters are painstaking, but they seldom rush about anything. The easiest cages to construct were simple boxes with tops that could be lifted off. However, we spent so much time chasing escapees that we quickly decided upon sliding-door cages, even though they were slower to construct. Even then, if the wooden door shrank, as it usually did, the shrews used their snouts ingeniously as levers for moving it aside.

When the elephant shrews escaped from the building, they usually hugged the outside walls and were easily recaptured. A few darted across open ground to a building 25 feet away, but there they stayed and were also easily retaken. One eluded us for two days until a boy chasing grasshoppers saw it, bedraggled and unhappy, in a drain pipe of the near-by building where it had probably been all the time. During the daytime, the fugitives ran on all four legs, but at night they made for their objective directly with great hops on their hind legs, the short forelegs touching the ground only briefly.

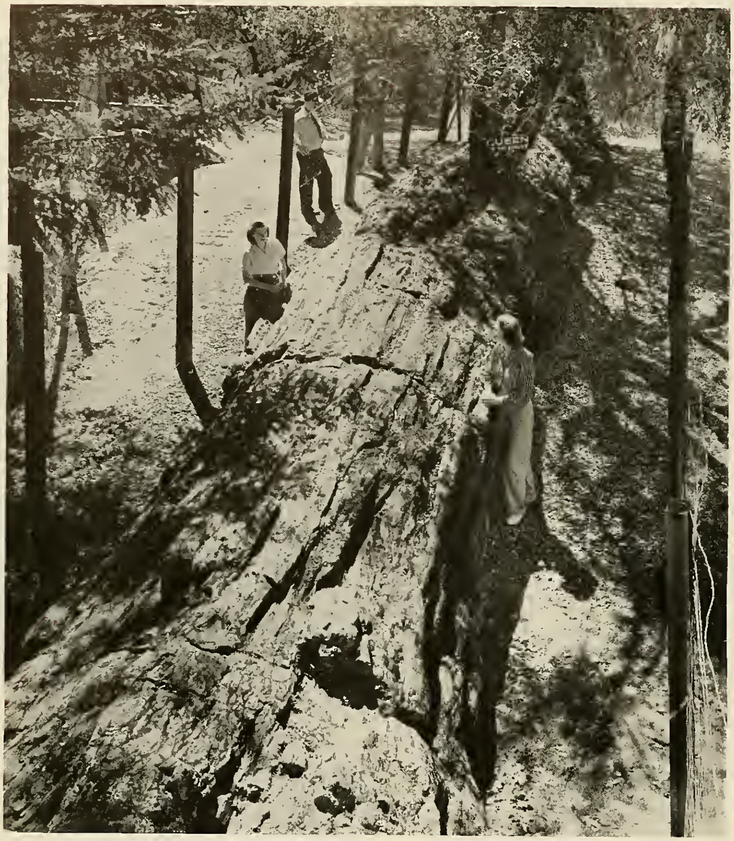
When we caged several animals together, they huddled in a pile, and their combined heat changed their sleek fur coats to soggy mats. Their abject fear was caused by domineering males who scratched and bit at any member of the group that dared move. So, as quickly as we could, we obtained enough cages to keep pairs separately. The animals obviously preferred to be with at least one other. Whenever one in a single cage could climb over the partition and huddle next to another animal, it would do so. We noticed that if we removed both from a cage and then put one of them back in

Continued on page 140



Gladys Terry photo

▲ WILLIAM TERRY and the author feeding newly-captured shrews with milk from a medicine dropper. Development of a diet on which the animals would thrive under observation at the Naval Medical Research Institute required considerable experimentation. These are probably the first elephant shrews ever to reach the United States alive



▲ "THE QUEEN" of the petrified giants: one of the huge redwoods that were overthrown several million years ago by a volcanic eruption and then turned to stone

▼ MT. ST. HELENA in California's Coast Range, at whose base the stone trees lie. It was here that Robert Louis Stevenson honeymooned with Fannie Osbourne and wrote *The Silverado Squatters*

STON

# of the Re

Millions of years ago these monarchs met a violent death, yet in the strange manner of their destruction they were preserved for all time

By

DOLORES BUTTERFIELD JEFFORDS

Photos courtesy of the Redwood Empire Association

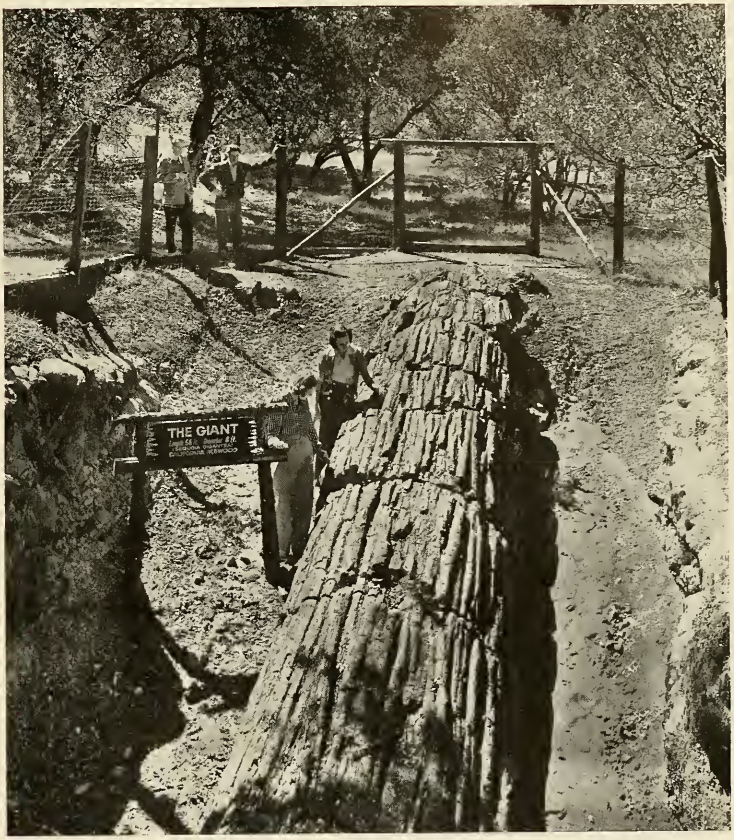
THE scene: the westernmost edge of a great continent. The setting: a forest of giant redwoods, towering to a height of over 300 feet, against the backdrop of a mountain range. The time: several million years ago.

Many of those redwoods had been growing in that kindly soil for some 3000 years. How many thousands of years longer they might have flourished there, no one can say, for the natural life span of the redwoods is still undetermined. So far as is known, they never die—they succumb only to violence, as did these. The mountain at whose base they grew exploded and gave forth ash, mud, and red-hot lava, which spread desolation for miles around over the quaking earth. When the eruption was over, the forest of giants lay prostrate under a vast blanket of volcanic waste.

Thus has science reconstructed the prehistoric drama of Mount St. Helena and the underground petrified forest in Sonoma County, in California's Redwood Empire. Their long imprisonment beneath the volcanic ash transformed the huge trees into columns of siliceous

TREES

ood Empire



▲ "The Giant," like the other trees in this fallen forest, apparently lost its top before petrification could preserve it

rock. In 1871, the tract was discovered, and gradually since that time a number of the trees have been excavated in an area about one mile long by a quarter of a mile wide.

Unlike other petrified forests, which consist largely of stumps and broken fragments, this one is composed of huge trunks of the largest of all trees, many of them almost entire. Many have been uncovered at a depth of 90 feet below the present ground surface, lying one above another, their tops, with significant uniformity, pointed away from the mountain that destroyed them. Yet, in destroying them, it preserved them for all time—preserved them in stone, with the most minute perfection of bark and grain and even of the growth rings that reveal how many centuries they stood there before the eruption felled them.

▲ Geysers, mud-pots, and mineral springs give evidence of the subsurface activity that caused the ancient cataclysm

The process of petrifaction included a few worms embedded in the wood of some of the trees. And leaf imprints have been found, although the petrified trunks are topless and rootless, as if the extremities of the trees, less completely covered, had disintegrated before subsequent eruptions or the accumulated soil of thousands of centuries buried them more deeply.

The individual trees of this stone forest have names, the most celebrated being "The Queen of the Forest," "The Giant," and "The Monarch." "The Queen" is a tremendously massive column 80 feet long. "The Giant," despite its name, is smaller—56 feet long and 8 feet in mean diameter. Being redwoods, these trees must have been taller; part of their length must not have been fossilized. Both of these trunks are broken into several sections, but there is no displacement to mar the impression of the whole, except that two sections of "The Queen" have been thrust apart by a thriving live oak that has grown between them.

"The Monarch" is the most perfect of these petrified redwoods, having an unbroken length of 126 feet excavated thus far, part of it exposed, part lying in a tunnel dug around it. When fully excavated, it is believed it may be 300 feet long. Its age at the time of the eruption may have been 3000 years.

There are petrified pines among these trees, easily distinguishable from the smaller redwoods by their perfectly preserved bark texture.

Mount St. Helena has long been peacefully extinct. It is a domi-

▲ **Forests** again clothe the slopes of the long-inactive volcano. Today the region is a favorite vacationland, accessible by a network of all-year highways

nant peak of the Coast Range and was named by the Russian settlers who, despite protests of the Spanish government and the succeeding Mexican government, held possession of northwestern California from 1811 to 1841. It was on Mount St. Helena that Robert Louis Stevenson honeymooned with Fannie Osbourne in 1880 and wrote *The Silverado Squatters*. The site of the bunkhouse they occupied on the mountainside is marked by a monument dedicated to the famous author, representing an open book.

St. Helena is beautiful now. Forests again clothe its slopes below the high, bare peak, and orchards blossom around it. A modern highway winds to the top, where the Russians placed a tablet in honor of their empress. The surrounding area abounds in geysers, hot mineral springs, bubbling mudholes, fumaroles, and other post-volcanic phenomena. And near by is a mountain of obsidian, a mass of black volcanic glass. This is the locale of many health resorts, a year-round vacationland, a place of both historic and prehistoric interest, and a favorite region for scientists to study the continuing thermal activities near a long inactive volcano.

But the outstanding exhibit of the region is the Petrified Forest at the base of Mount St. Helena, on the Petrified Forest Highway, five miles west of Calistoga. How far that buried forest actually extends, how deep some parts of it may lie, will perhaps never be known. Nor can we guess how many other such forests, laid low by cataclysmic upheavals in past ages, may lie in the Redwood Empire under the roots of their towering descendants of today. It is enough that here, imperishable even in death, vastly older than the oldest present redwoods, are giant trees that lived and flourished millions of years ago; trees that for eons of time lay under the earth, to emerge at last transmuted to stone, with lifelike preservation of every mark, grain, and fiber. Here, in the light of another day, infinitely removed from their own, they can only be viewed with wonder and awe and with a profound recognition of the fact that, despite all our scientific advancement, there are still "more things in heaven and earth . . . than are dreamt of . . ."

Sea

THE quartermaster at the wheel nodded in the direction of a dark heavy-bodied bird that veered sharply into the twenty-knot breeze to miss the "Penguin's" pilothouse and skim heavily over her spray-drenched bow. "That bird is a sea parrot," he volunteered, "but they can't talk," he added, with the air of one who has been disappointed. "All they can do is bite, and they do that mighty well. Better not let one get ahold of your finger or he'll pretty near take it off." I didn't interrupt him to say that to landlubbers the bird is known as a tufted puffin, since to sailors all puffins are "sea parrots."

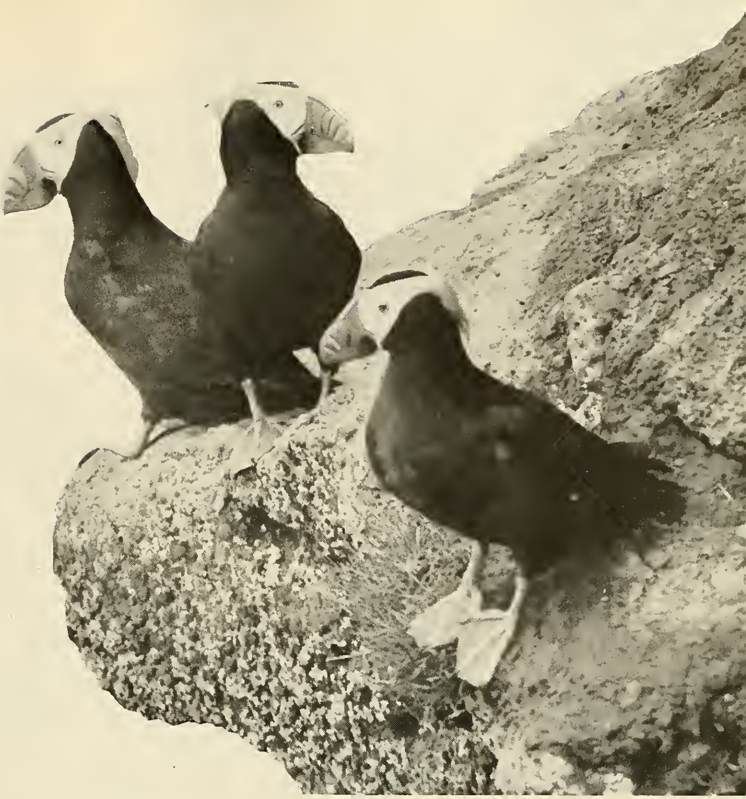
We were aboard the motor ship "Penguin" on her May trip to the Pribilof Islands. Five times a year she makes the 5,000-mile round trip to carry supplies from Seattle to the fur seal islands in the middle

Parrots

Some birds stand to lose more than feathers during the postnuptial molt. Take the puffin, for example

By Karl W. Kenyon
U. S. Fish and Wildlife Service

All photographs by the author



▲ **Two species of puffins** are abundant on the Pribilof Islands. The tufted puffin, shown here, is all black, except for its white face and ear tufts, whereas the horned puffin is white underneath. Puffins appear to prefer the company of their own species

of the Bering Sea. As we rolled and pitched through the rough, dark waters of the Bering, still over 100 miles from the Pribilofs, two species of puffins frequently skimmed near us over the choppy sea or rode like jaunty corks on its surface. Sometimes those swimming in our path turned sharply into the wind and, bouncing from one wave crest to another, finally lifted their chunky bodies on rapidly beating wings into the gusty wind. Others, with apparently no intention of actually becoming air-borne, simply folded their bright orange feet back across their rump, as if to get them out of the way, then hydroplaned over the surface on their bellies, using their wings as giant oars, until they were well clear of the ship.

"Even at a distance you can tell the two kinds of sea parrots apart," the sailor went on. "One is white underneath and the other is all black, except for his white face and ear tufts."

The sailor referred to the two species of puffins found in the Pacific and Bering Sea, the dark-bodied bird being the tufted puffin and the one with the white underparts the horned puffin. Puffins are characteristic of northern seas. Like other members of the auk family, they are circumpolar in distribution and seldom venture south to warmer waters. An Atlantic species ranges from the Arctic southward to the British Isles, the coast of Maine, etc. It embraces three geographical races, but they are indistinguishable in the field.

The tufted puffin enjoys a wider breeding range than any other bird found nesting on the Pribilofs. It nests on many of the small islands along the west coast as far south as Anacapa Island off Southern California. The horned species, like its relatives in other northern seas, is confined to more northerly areas and nests only on the islands of the Bering Sea and along the coasts of Alaska and Siberia. Even in winter, few of them venture south as far as California. Dead specimens have been picked up on the beaches of Southern California, but these birds were probably storm-driven individuals that became weakened by heavy winds and seas, finally to wash ashore south of their normal range.

Other sea birds besides the puf-

▼ **The author's** valuable Aleut assistant, Lavrenty Stepetin, who knew how to handle puffins and had due respect for their strong, sharp bills. The birds are well aware of the strength of their bills and inflict painful cuts if carelessly handled

▲ **Puffins** are sociable birds; they often gather in groups, as shown here, to enjoy the company of their neighbors

➤ **Benny Melovedov**, an Aleut boy of the Pribilof Islands, holds a puffin chick. Although the young puffin used its bill on fingers that came within reach, it was not strong enough to inflict cuts, and it lacked the aggressive attitude of an adult puffin

fins were often about the ship as she plowed doggedly through the tossing seas toward the north. Half a dozen glaucous-winged gulls had followed us from Unalaska, in the Aleutians, and an occasional kittiwake passed at a distance, ignoring and aloof. Least auklets and crested and paroquet auklets sometimes took wing, more lightly than the heavy puffins, or hurriedly dived as our bow broke water near them.

Puffins are frequently noticed by sailors because of their heavy, strikingly-colored bill and relatively large size (about that of a large pigeon). "I found one in a hole on a little island in the Aleutians where we stopped a couple of summers back," the quartermaster continued, "and when I put my hand in to grab him, he grabbed me instead." He held up his right index finger to display a long white scar line just below the fingernail. "I bled like a stuck pig and haven't bothered sea parrots since." Unlike the bills of hawks and owls, which are relatively weak, the bills of such fish-eating birds as the puffin are strong grasping devices.

Later in the spring I had an opportunity to dig a puffin from its burrow and, remembering the sailor's experience, wore a pair of heavy gloves. The burrow was about four feet deep. About halfway to the enlarged chamber, where the single egg rested, it turned rather sharply to the left. When I had reached this point, the puffin decided to make a dash for freedom. As I grasped the escaping bird, I found that I had been wise to heed the sailor's misfortune. Even through heavy gloves the strong, sharp cutting edges of the puffin's bill dealt me several hearty pinches. Puffins are well aware of the power and effectiveness of their bills and when handled make every effort to use them.

Besides acting as a useful weapon of defense, the bill is employed in the excavation of the burrows in which these birds nest, and its razor-sharp edges serve well in their fishing activities. The brilliant colors of the bill are part of the puffin's nuptial adornment. Both sexes are marked alike, and during the breeding season the bill of the tufted puffin is largely a brilliant red-orange, with a pale waxy-green area at its base. That of the horned puffin is a pale lemon-yellow, tipped with shades of red. At the corners of the bill, a leaf-shaped wattle of flesh protrudes. This is crimson in the tufted puffin and yellow-orange in the horned.

After the breeding season has

◂ A PAIR of horned puffins carry on their courtship at the entrance to their summer home in a basaltic Pribilof cliff. The birds sit for hours on such perches, caressing each other with their bills

▾ THIS HORNED PUFFIN stands posed for a few seconds to stretch its wings before gliding away into the strong sea breeze that sweeps up over the face of the cliff

passed, the puffins lose their spectacular bills. In the late fall, the bill plates begin to loosen at the edges and scale off. The new bill, which is revealed as the sheath of the old one falls away, is smaller and duller in color. The bill plates are shed at the time of the postnuptial molt, when the tufted puffin also loses its streaming breeding plumes and retains only a few little white wisps behind the eye for the modest adornment of its winter dress. The white face, too, disappears and is replaced by dark feathers, so that as winter approaches, the adults take on much the same appearance as the young birds during their first winter.

Puffins range far at sea during the winter months and seem at home on the high seas even during the stormiest weather; yet they appear equally contented when they gather on wind-swept island cliffs during the summer nesting season. They begin to arrive in May, and you see numbers of them flying along the cliff edges or resting on the rocky projections and ledges to carry on their courtship. When a human intruder visits their nesting cliffs, their curiosity is aroused and they circle close by time after time, retarding the speed of their flight as they glide in on the strong upwelling wind that sweeps from the sea and rises abruptly against the face of the cliff. With necks stretched and orange feet spread to steady them, they stare inquisitively for a few seconds and are then off again for another circle. In the early spring the Aleuts take advantage of the natural curiosity of the puffins, as they do of the smaller auklets, by catching them for food in long-handled nets or by knocking them from the air with sticks.

Wild creatures must face many tests of their fitness to their environment. Thus, when we find a defective individual that survives these hardships, we cannot help wondering how he succeeded. In the summer of 1947, I found a tufted puffin handicapped by a blind eye. The bird was resting on

▲ Puffins seldom wait long enough to give a photographer a chance for a close-up like this one. Usually they launch themselves into the steady breeze, their bright orange feet spread as stabilizers while they gather speed. Then they circle back and take a close look at the human intruder

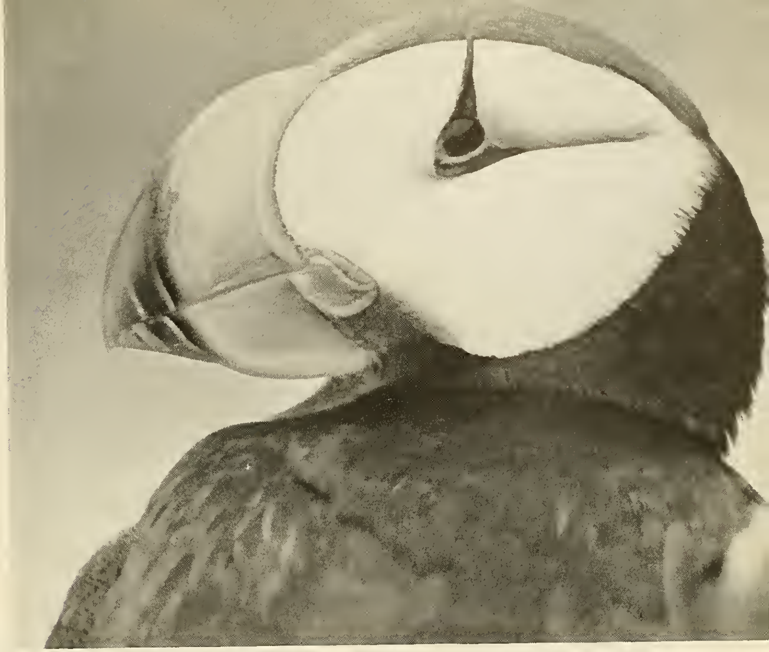
a rock that projected from the cliff, and from the edge of the cliff I could look down on him only a few feet away. Since his bad eye was turned toward me while he watched the circling birds near by, I was able to approach closely without frightening him. Apparently his eye had been injured by some accident or was affected by disease, since it was covered by a heavy, opaque membrane. To have found a one-eyed bird was not so strange. However, I was somewhat surprised when the following summer I found the same bird seated in precisely the same position on the same rock. He was undoubtedly a wise old bird that had weathered many seasons. He had the look of age about him. Although he seemed in good condition, his feathers were less sleek and glossy than those of near-by puffins, and he seemed a lonely fellow, apart from the others. I looked again for him last summer, but he failed to appear on his old perch. Apparently his blindness, coupled with old age, worked too strongly against him in the stormy winter of the northern seas.

For their nesting places puffins choose natural cavities in broken rocky cliffs or excavate a burrow in soft island topsoil. Although horned puffins prefer the faces of cliffs, the tufted ones often honeycomb loamy island slopes with their burrows. On such islands they dot the hillsides like tiny sentinels, sitting bolt upright near the entrances of their homes. Where foxes inhabit their nesting islands, as they do on many of the Aleutian and Pribilof Islands, both species are limited for safety's sake to cliffside nests. Aside from the labor of excavating, the puffins trouble themselves little over the details of nest building. The burrows that I have looked into contained only a careless scattering of grass stems or a few large feathers. Judging from the bedraggled appearance of these feathers, the birds must have found them floating on the surface of the sea. I have seen puffins returning to their nest holes from the sea with a primary feather of a gull held crosswise in the bill, in the same manner that they bring fish to their young.

The single egg is a lusterless white, faintly marked with varying amounts of pale brown and violet. It is large in proportion to the size of the bird, as are the eggs of other members of the auk family. The chicks hatch well covered with dull gray down, and their eyes are open and alert.

Puffin chicks make friendly and comical pets. They tame rapidly and are greedy eaters. The difficult part of securing a puffin chick for a pet on the Pribilofs is getting it from its nest. This is only possible through the use of a long rope and enough nerve to lower oneself down over a crumbling cliff edge. One afternoon I decided to make such a climb and found that locating a young puffin was one thing and extracting it from its hole in the rocks another. After looking into a number of deep and dark but empty crevices, I suddenly caught a glimpse of a ball of down well back in a dim recess. The little bird had no desire to leave its

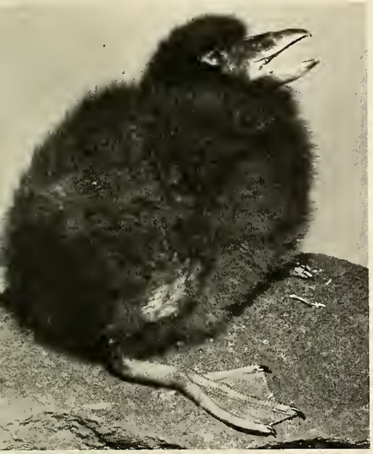
▼ With the aid of their strong bills, tufte puffins dig burrows in the soil three or fou feet deep. Where foxes and other predator animals do not force them to use the shee cliffs, the puffins honeycomb the topsoil o the islands with their underground homes They lay a single lightly marked or nearl white egg



▲ The so-called "horn" of the horned puffin is really not a horny structure but a projection of erectile tissue attached to the upper eyelid. It is raised when the bird is alert. The large bill, besides acting as nuptial adornment and an effective instrument for catching small fish, proves useful in excavating the nesting burrow

cozy quarters and scampered back to the darkest corner, where it turned a truculent, beady eye in my direction and refused to move. Since it was well beyond the reach of my arm, I shouted instructions to my helpers above, and a long-handled net came down over the cliff at the end of a line. With this I succeeded in introducing the young puffin to the light of day.

It proved to be a tufted puffin and once in hand appeared quite contented and interested—mainly in fingers, which it apparently mistook for tasty bits of fish. We found later that the young bird could consume at one sitting a handful of chopped fish equal to nearly half its own bulk. Even when full to capacity—to the extent that as it opened its bill to chirp for more, the last piece eaten threatened to escape—it seemed anxious to try to pack in still another morsel.



▲ The dark sepia bill of this young tufted puffin shows little resemblance to the massive orange one of its parents. Puffin chicks are gluttonous. This one continued to beg for fish scraps even after it was packed to the point of spilling over

On rare sunny Pribilof afternoons when I found myself free of other work, Lavrenty Stepetin, an Aleut boy interested in my work with birds, would help me round up my equipment, and we would go out along the cliff tops to locate photographic subjects. Lavrenty has spent most of his life on St. Paul, largest island in the Pribilof group, and was always a welcome assistant on such field trips. On these sunny afternoons we found the sociable puffins relaxing on the rocky projections of the cliffs near their nest holes. They enjoy the company of their neighbors and sit for long periods watching the host of murres and kittiwakes streaming back and forth between the cliffs and fishing grounds. It would not seem a difficult task to locate these resting birds, then lean out to take a photograph. However, the puffins are often quite wary of human visitors and usually glide away toward the sea, preferring to circle back to take in the situation from an aerial vantage point. Thus it was usually necessary to stalk carefully through the tall rye grass at the cliff edges, and Lavrenty proved a very able helper in securing the photographs accompanying this article.

In late September and October, most of the murres and small auklets have led their young away to the sea before the puffins leave their nesting cliffs. Not until harsh storms are lashing the Pribilof cliffs with a fury of wind and wave do the hardy puffins sever ties with their summer home and go to the open sea for six or seven months.

Snowflakes swirled about us as the "Penguin" turned her bow away from the Pribilofs and headed toward Seattle.

"Where do all the sea parrots go in the winter?" asked the sailor who had told us of his experiences with the birds a few months earlier. A drab brown bird paddled hurriedly away from our starboard bow, and I pointed it out to him. "Well, I'll be darned. I've heard of birds losing their bright feathers come winter, but this is the first time I've ever heard of a bird changing its bill, too. I wonder if they bite as hard with that little winter bill as they do with the big summer one," he mused.

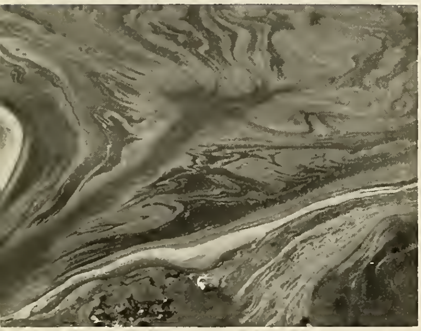
▲ VISITORS TO Hancock Park look at the stagnant pond that was a death trap for great numbers of prehistoric animals

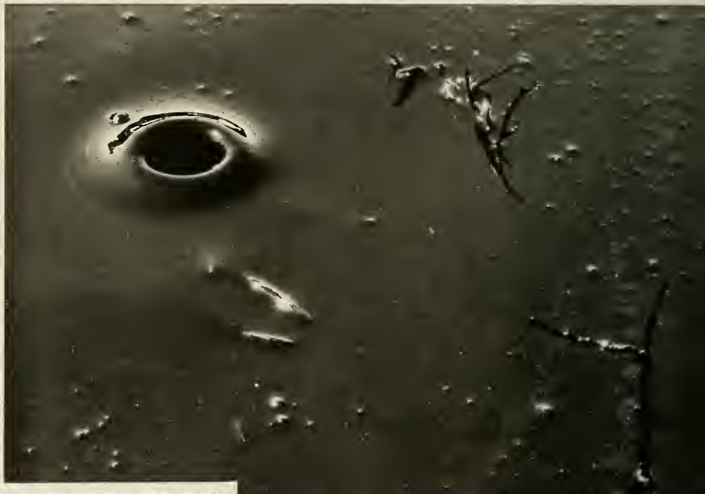
TAR
Tre

By BLACK

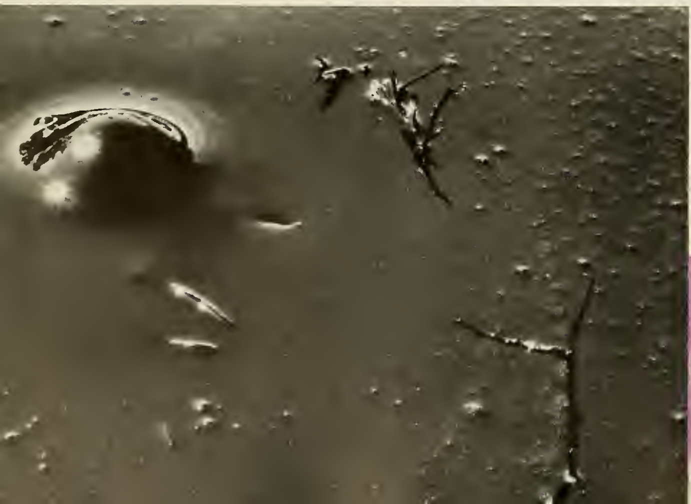
All photo

▼ OIL SEEPS continuously from the tar (bottom of picture) and flows out in streaks across the surface of the water





▲ THE BUBBLE has burst, and the surface is flattten-ing out



◄ A BUBBLE rising in the soft tar reaches the surface. The twigs have been trapped in the tar

RAP

sure

MPHREY

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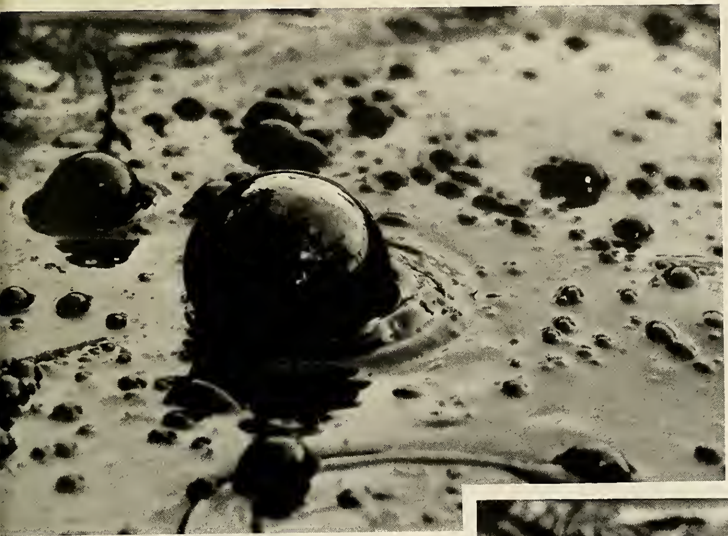
Amid the ultrasophistication of the twentieth century, scenes of 50,000 years ago depict the animal life of a vanished era at the world-famous tar pits in Los Angeles

NOT all the strange goings-on in Los Angeles are of human origin. In one of the city's blocks the earth itself acts bewitched, or at least pixilated. Tar and oil continually seep from below the surface in a weird display of bulges, bubbles, streaks, and slicks. The place is called La Brea—Spanish for "the tar." The block is surrounded by stores, office buildings, and apartment houses but is itself kept as a public park—Hancock Park—not only because of the strange attributes already mentioned but also because of what has been—and in the future still may be—excavated from its tar.

For, back in prehistoric times, animals (many of them species now extinct) wallowed in the tar, got stuck, and died there. The flesh decayed, but the bones remained. Scientists have already dug up great quantities of them. Complete skeletons have been assembled and are on display at the Los Angeles County Museum. Under the direction of Dr. Chester Stock, who is the museum's Director of Science, Mr. George Kanakoff is soon to start digging again, seeking more bones and more knowledge. The new excavation is to be left open as a permanent exhibit that will show the public how the bones are found.

The fossils already obtained make up a unique collection, famous among geologists, for they comprise the world's largest assemblage of vertebrate Pleistocene animals. Yet many people who live near La Brea know little or nothing about this amazing place. It has not yet been subjected to much modern im-



OF THIS MASS of bubbles, the most con- icuous one is growing rapidly. It reflects e sky and the surrounding trees and fence

➤ THROUGH THE HOLE in the center the bubble has burst, and its shell, which apparently had become somewhat hardened, has collapsed

Mural by Charles R. Knight in the American Museum, AMNH photo

▲ A MASS OF BONES exhibited in the jumbled fashion in which they were found when excavated

provement. The ground is uneven and dotted with scattered, uncultivated plants and with a few ponds of stagnant water. They look much like any stagnant ponds, but on close inspection you can see the tar and gas coming up through the water and along the shores.

Occasionally a sound of loud bubbling will attract the attention. It is gas escaping suddenly from below the pond, leaving small water bubbles on the surface and starting concentric circles dancing across it. In the same spot, tar is coming up. It comes in shafts or ribbons, fairly vertical until they reach the surface, where they float and weave like weathervanes as the water current (the slight, vacillating, wind-caused current of a stagnant pond) may turn them. Purplish, oily scum floats off from the tar and across the pond.

Around the edge of the pond there is more tar. Much of it has hardened, but some of it is still fluid and active. It slowly rises in a small mound. The mound forms into a black bubble. There are other bubbles near it which have not changed noticeably in size. But this bubble grows larger and larger, keeps growing for a minute or two —and then suddenly it bursts. The others remain; this one has paid the price of ambition. The gas has escaped; the tar sinks back into a sort of small crater and quickly flattens out.

The oil and tar and gas originated in layers of rock that, even in Pleistocene times, were ancient and far below the surface. The earth pressed down upon the oil and tar and gas, which oozed out on the surface. During the Pleistocene period, the oil and tar formed large pools, some of them many square feet in area and extending to depths as great as 30 feet. The tar, exposed to the air, hardened, and soil has since blown or washed over most of it. But when it was exposed in large pools, many animals were caught in it. Some may have wandered that way purely by chance; others came to drink the water which, then as now, collected in the depressions of the soil. Dr. Stock has written, "It is not difficult to visualize some of these Pleistocene catastrophes. A single animal, large or small, becoming mired in the tar would as a result of its struggles and cries lure others to the trap. The carnivorous birds and mammals seeking to reach this bait would frequently fall victims to the tenacious grip of the viscous material and thus in turn would serve to attract still other creatures to the pool." Dr. Stock explains that the excavated fossils contained preponderant numbers of predatory forms and also many young, aged, and maimed individuals. Animals that couldn't take good care of themselves were at a special disadvantage at La Brea.

Although the tar now covers much smaller areas and is less active, it is still said to be a danger to small animals such as ground squirrels; indeed, the museum has on exhibition the body of a bird mired in the tar. But such tragedies are now rare. On several visits to La Brea, I did not find a sign of any animal caught in the tar, though leaves and twigs illustrated how creatures would stick and sink in it. The tarry depressions are now individually surrounded by high wire fences.

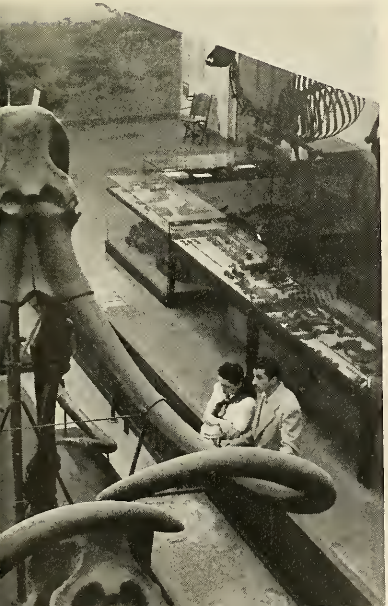
Though these depressions seem weirdly primeval, most of them are the work of man, being the holes left after excavation. Now man—in the person of the Los Angeles County Museum—is giving a facelifting to the surrounding plain, at least to the block that the growing city has not already eaten up. He has felled trees and scraped the ground bare. He has erected concrete statues of Pleistocene animals and has built two modernistic comfort stations. He promises 55,000 square feet of paved walks, a complete lighting system, and stream and lagoon construction. He prom-

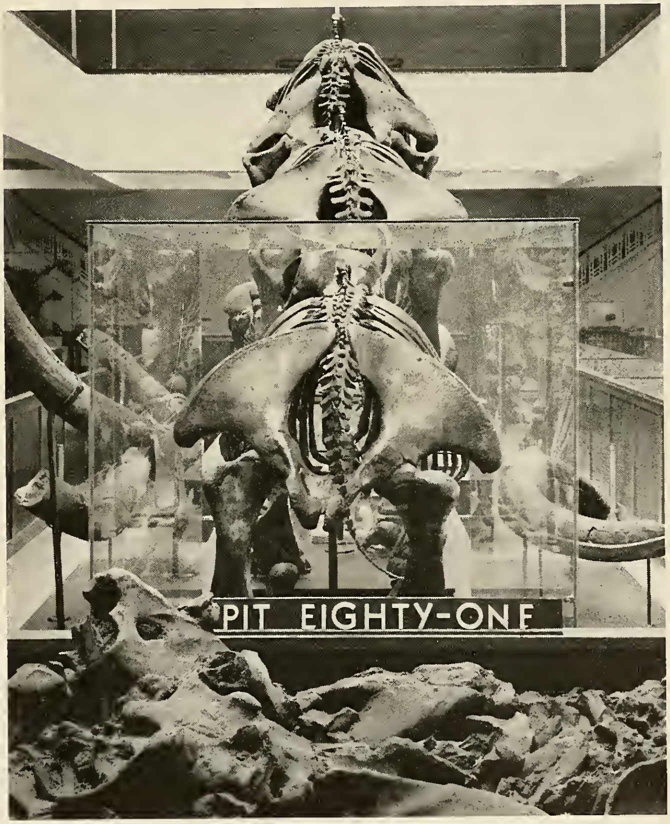
ises also "an elaborate landscaping scene to simulate as far as possible" the setting as it was when the ancient animals were trapped. This means more vegetation, for it is believed that the climate was not so dry then. Many types of trees and shrubs that lived here then are still found in other parts of California and can be made to grow here again by cultivation. Some time further in the future, a new museum is to be built in the park (the present museum is many blocks away), and the present statues are to be replaced with better ones.

Let us hope that the result will not look like just another city park, hiding the primeval burpings of the tar or inharmonious with them. Perhaps the skill of man, and a $738,400 project, are necessary to make a modern wilderness look like an ancient wilderness. Especially with paved walks and comfort stations. We must wait and see.

We can already see, in the museum exhibits, a sample of what the excavators dug up from the depths. They made such huge hauls that much of the material is not on display; there are boxes and boxes of bones stored in the basement, with one discarded skeleton perched eerily on top of them. More than 180 different kinds of animals and plants have been recovered. Of mammals alone, more than 4,000 individuals are represented in the museum's collection. When the excavators dug down into the tar to see what they could see, they found bones distributed quite irregularly. In some areas there would be few or none; in others there would be amazingly dense collections. One such jumble of bones is mounted as an exhibit in the museum.

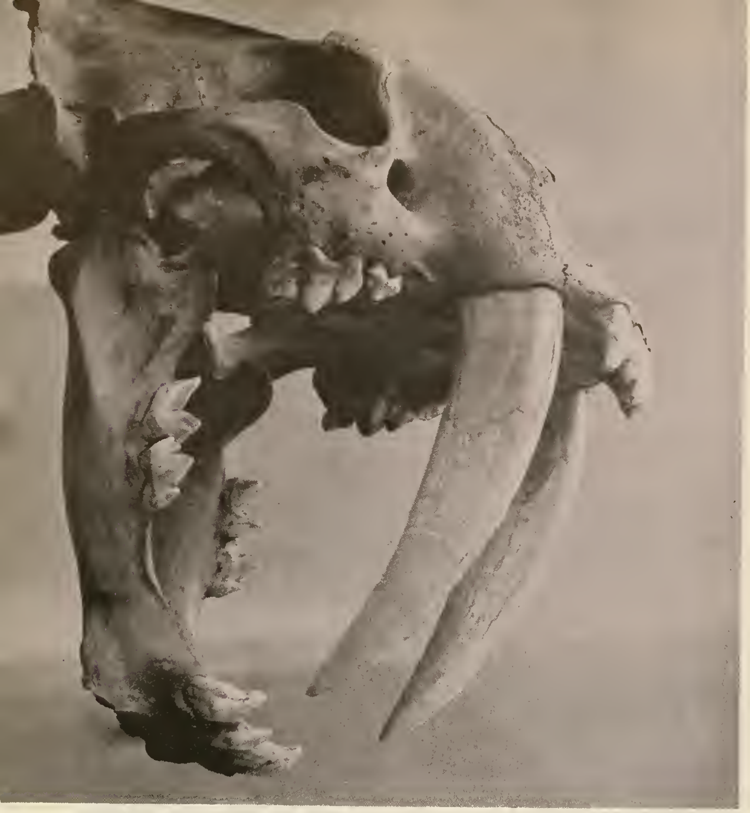
Nature was kind to the scientists not only in the quantity of animals trapped at La Brea but also in the quality of preservation. Although the softer tissues disappeared, the harder parts remained intact. Limb bones retain many surface markings, indicating the courses of nerves and blood vessels and the places where tendons and ligaments were attached. Teeth show the wear their owners gave them. Some bones and teeth exhibit the effects of injury and disease; there are fractured bones that had healed. While the tar preserved the bones that sank within it, some did not sink until they had been gnawed on. In these cases, the marks of the gnawing were preserved—and the scientists can tell which were made by carnivores, which by rodents. Other bones remained exposed to the atmosphere for some time be-





◄ HANCOCK HALL, Los Angeles County Museum. Reconstructed in the foreground is a prehistoric elephant. The original tusks of this specimen were not recovered, but duplicates were fabricated. The painting in the background by the famous artist Charles R. Knight shows his conception of La Brea in Pleistocene days

▲ AS IF ARISING from the confused bone-pile in the foreground, the skeleton of an immature mastodon ambles away. Ahead of it is a mature mastodon and beyond that an elephant



▲ Head of a saber-toothed cat. The lower jaw closed between the large canine teeth

fore sinking in the tar. They show the same effects of weathering as do modern bones lying on the western plains. In some cases there is another type of wear: the boneladen tar apparently shifted so much that the bones were scratched.

Some of the bones are enormous. They came from enormous animals: the elephant skeleton mounted at the museum measures eleven feet, seven inches to the top of the skull, and the skull itself is nothing to toss lightly around. But the tar also preserved many small things for the painstaking scientists to recover. In some skulls, the tiny bones of the inner ear were intact. Seeds and cones and even leaves have been found; fragments of insects have been identified. The smallest exhibits in the museum's collection are mounted on microscope slides. Some of them may be hair. Miss Gretchen Sibley, a member of the staff who is working for her doctorate, is examining longitudinal and latitudinal cross sections as well as casts and molds, hoping to learn more about what the cautious scientists at present refer to as "material resembling hair."

Among La Brea mammals, flesheaters form a large majority. If they had occurred in the same proportions over a large territory, they just wouldn't have had enough flesh to eat. Of course, they came to the tar pits to feed—and stayed to die. Of these carnivores, most belong to the dog family (wolves, coyotes, and foxes) and the cat family. There are also a few bears and other forms.

Of the cats, the most frequent and the most amazing is the sabertooth. Its two dagger-like canine teeth make even a skeleton look ferocious. This animal was of about the size of an African lion. Unlike the lion, it was not fleet-footed but depended for its food on its ability to grapple and fight at close quarters. Not that any witness has described such a fight; the last of these creatures died before recorded history began. But scientists can deduce an animal's habits from the shape of its bones. Light hind limbs and strong front limbs indicate a fighter, not a runner. The rib basket and breastbone bear out the contention. And those teeth—well, here's how Dr. Stock reconstructs the past: "In attacking a large mammal like an elephant . . ., the saber-toothed cat would probably seek a vulnerable spot on the body or neck of its prey, grip the victim with its powerful front limbs and claws, and repeatedly stab with the upper canines, thus inflicting a jagged wound. In this attack the lower jaw was capable of swinging downward, giving a considerable gape to the mouth, the powerful head and neck muscles furnishing at the same time a strong thrust

▼ Left front foot of a prehistoric elephant that once roamed near the heart of present-day Los Angeles

▲ **ALL** of its relatives have become extinct in North America since the day when this camel scanned the California landscape

◀ **HEAD** of a bison

which accompanied the stabbing action of the teeth. The backward position of the nasal opening presumably permitted the animal to breathe with head plunged deeply into the side of its victim . . ." Occasionally one or even both of the saber-like teeth would be broken. Their broken edges, now recovered from the tar, are worn smooth, showing that the cats continued using them after they were broken. The cheek teeth of such individuals also frequently show excessive wear, suggesting that the animal found greater need for them after the canines were damaged.

So much for the carnivores. The other mammals are fewer but in many cases larger. The elephant is largest—larger indeed than the elephants now living—and adorned with huge tusks. Next in size is the mastodon, whose tusks are small by comparison. There is also an extinct bison, larger than the modern North American buffalo and having, like it, a forward hump on its back and horns on its head. There is a horse, which evolution had brought to the size of the modern horse and to one-toed feet. However, it was of a different species than horses now living; horses, like elephants, became extinct in America before the coming of the white man. Camels also became extinct on this continent, but one species is represented at La Brea. It presents a problem the scientists haven't been able to solve. They've reconstructed the skeleton of an entire camel—two, indeed—but the bones give no indication of whether or not the animal had a hump or humps. For, unlike the skeleton of a bison, the skeleton of a camel does not extend up into its hump.

Three of the other skeletons are of ground sloths. One is mounted erect on its hind feet and heavy tail. This isn't due to somebody's whim or an offhand guess. This time the bones did tell a story. The pelvis has a shelflike projection over the hip socket to support the weight of the erect body. The tail bones show that the tail was large, so that the sloth could use it for support and balance, as a kangaroo does. This is the paramylodon, or giant ground sloth. Beside it is another of the same species, this one mounted on all fours, showing how the animal looked when walking. Ahead of the two paramylodons is a nothrotherium, the smaller ground sloth. It is also on all fours, because it had a weaker tail and no projection over the hip socket and presumably could not stand erect.

Birds of about 115 different types have been recognized in the La Brea material. They are a rare find for paleontologists, since the delicate bones of birds are not preserved except under most favorable conditions. There are many predatory and scavenger types, presumably attracted by the animals trapped in the tar. There are also a few aquatic birds, presumably attracted by standing water. The birds vary greatly in size. Teratornis, an extinct vulture, is recognized as the largest known bird of flight; it stood two and a half feet high and had a wingspread of at least twelve feet.

Don't ask about dinosaurs, just because La Brea is full of fossils.

< VISITORS VIEW the skeleton of an elephant. Below it is a plaster model of the same species as it probably looked in life

∨ SCHOOL CHILDREN are awed by these giant specimens, as Miss Gretchen Sibley, museum lecturer, describes their interesting characteristics

La Brea animals lived in the Pleistocene period—and that's not very long ago, geologically speaking. Dr. Stock's latest opinion is that the animals were trapped in the tar from about 60,000 to about 40,000 years ago. And the dinosaurs all died long, long before that.

Various parts of plants have been recovered and identified, wood being the most common. An unusual find was the upright trunk of a conifer. It was eight feet high (above that it had burned or rotted away) and was rooted in the clay, twelve feet below the present ground level. The trunk was surrounded by clay, sand, and asphalt and by a dense mass of bones and skulls, all of which had obviously inundated it where it grew.

During the excavations, a human skull and a few other human bones were found. They were close together and clearly belonged to one individual. The construction of the bones indicated it was a woman. The shape of the skull, with high cheekbones, mark her as an American Indian—a modern type, from a geologist's point of view. The other animals represented in the same excavation indicate also that nature operated this particular booby trap in the geologic "Recent," not, like most of the pits, in the Pleistocene. The woman may have lived thousands of years ago, but not tens of thousands.

A few indications of man's presence were found in the other and more ancient excavations, including parts of atlatl darts. So perhaps human beings of some sort were around to see the ancient animals wallow and die; but if any of the Pleistocene people were careless enough to get stuck, the fact is still a secret of the tar.

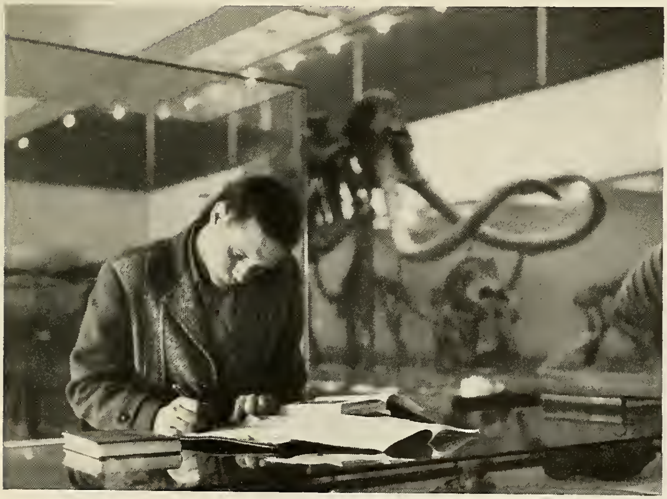
But what of modern times? How was this natural phenomenon discovered? In 1769, Gaspar de Portola saw "extensive swamps of bitumen," and debated "whether this substance, which flows melted from underneath the earth, could occasion so many earthquakes." In 1792, Jose Longinos Martinez wrote of the "great lake of pitch" in which animals had been seen to sink. He said that trapped animals were a source of game for the Indians and that bones of animals lost in the tar came up years later. In the 1860's, '70's, and '80's, the tar was dug up for use as roofing, paving, and fuel. The diggers came across many bones but tossed them aside in disgust, especially when the quantity made further commercial use of the tar impractical.

Along about 1905, scientists became interested. They've been digging off and on since and have made 100 or so excavations in various parts of that city block. Sometimes they didn't even find bones. Sometimes they did, and kept finding them as much as 50 feet below the surface. When they were through digging, they usually filled up the hole again. In a few cases, they did not fill it up all the way but left the depressions where the action of the tar may now be seen.

Well, after they'd dug something up, what did they have? A mess. A tarry mess. First thing was to get rid of the tar. So they immersed lumps of the material in vats of heated kerosene, supporting the lumps on a three-quarter inch mesh screen. Thus they removed and cleaned the large bones. Until recently, anything small enough to fall through the screen was lost—thrown out with the tar in a refuse dump. But the dump was preserved; and in 1947, Dr. W. Dwight Pierce and Mr. Kanakoff began recovering the small pieces by means of a Soxhlet apparatus, which held the tarry material in a filter cup. Hot benzine dripped over it, removed the tar, and was siphoned off. The objects that remained, many of them very small, were sifted through a series of screens, sorted, resorted, and studied.

As you may have gathered, the experts are quite clever at identifying the various parts. There are even specialists for different types of material. The late Dr. Roy L. Moodie has written about the ancient evidences of disease among the La Brea specimens. The late Dr. John C. Merriam and Dr. Stock brought La Brea its scientific fame through a book about the great cats. Dr. Alden Miller, Dr. Loye Miller, and Dr. Hildegard Howard have written books about La Brea's birds. Dr. Ralph W. Chaney is still working on the plant material.

When enough bones of one kind of animal are assembled, they may be set up as a complete skeleton. Most of this work has been done by Mr. Eugene Fisher, recently retired. In some cases, the bones of one individual animal were found close together in the tar; indeed, the museum has not only an adult mastodon skeleton but a young one trailing right behind it. If there are a few bones missing, the scientists make artificial replacements, which blend unobtrusively with the genuine parts but do not deceive a careful, trained observer. If there's a bone left over—well, as yet the museum personnel has resisted a strong temptation to give one of the skeletons an extra bone to carry between its jaws.



▲ Boning up on bones: one of the many twentieth-century students who frequent Hancock Hall to take notes

Hancock Hall, which contains the tar-pit exhibits, is large enough to give them space to be seen. Museums nowadays know something about effective display. The huge skeletons march behind each other like some fantastic circus parade. They are dark brown, since no amount of cleaning can remove the stain of the tar, which has penetrated the hardest layers of bones and teeth. The skeletons are silhouetted against a plain, light-toned wall.

The place is open to the public, of course, and people of all sorts wander through for a look. Almost any morning of a school day, two or three classes of children will have sessions with the fossils. Their regular teachers come along too, but the museum supplies its own speakers. Occasionally a group of older students will spend a few hours of research in the room, reading, peering at the bones, and scribbling in their notebooks.

Out at La Brea, the tar still bubbles, and the construction gangs go on working. Perhaps they can bring back the wilderness. We may hope at least that the museum will use its knowledge of display to show the public the origins of the fossils as tastefully as it shows the reconstructed skeletons. We may hope that Dr. Stock's effort to transplant trees and shrubs such as grew there in the Ice Age will serve to hide the comfort stations. We may wish Mr. Kanakoff luck when he starts digging again. The workmen have built him a house to dig under; when he's through digging, the new excavation is to be preserved there as a permanent exhibit. A test boring has told him there are some bones to be found in the spot selected. Let's hope he will have a rich harvest.

HOW A Rattlesnake Strikes

The superspeed camera shows how the snake spears its victim with its venomous fangs

By Walker Van Riper

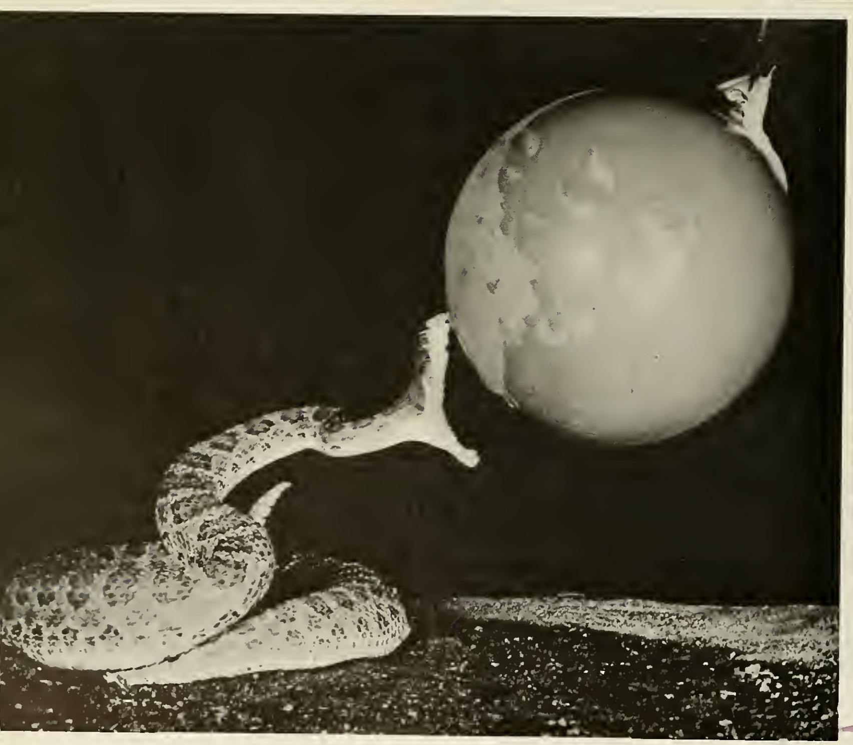
Denver Museum of Natural History

Photographs by the author

THAT the strike of the rattlesnake culminates in a stab rather than a bite is shown in the accompanying pictures. The venom-injecting apparatus of this reptile consists of two long and hollow teeth, the fangs, which are provided with holes near the point for discharge of the venom and are connected in the rear with venom glands and muscles that force the venom outward. The fangs are, in fact, the exact counterparts of hypodermic needles.

At rest, the fangs lie back against the upper jaw, almost parallel to the floor of the mouth, and are covered with a white membranous sheath. When the mouth is opened wide for a strike, the upper jawbone is rotated through nearly a 90-degree angle. The fangs are, at the same time, raised so that they point forward at the moment of impact. Only the points show, because the rest of the fangs are covered by the white cone-shaped sheaths. The photographs show how extremely wide the jaws are opened and that they remain wide open until the withdrawal movement is well under way. The snake shown is the Prairie Rattlesnake, *Crotalus viridis viridis.*

These pictures of the strike were taken with the high-speed electric flash invented by Dr. Harold E. Edgerton of M.I.T. Exposures are on the order of 1/10,000 of a second. Small rubber target balloons were employed in such a way as to trigger the flash at three different points during the strike. To get the flash at the exact moment of impact, the surface of the balloon was made conductive by dipping it in a warm salt solution, and the wire on which the balloon hung was



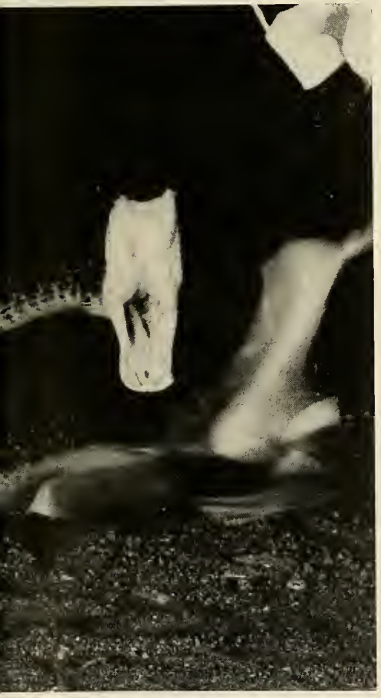
◀ AT THE MOMENT of contact, the jaws are spread wide and the fangs brought forward so that their points stab the target

▲ The tongue projecting from the mouth of the Prairie Rattler in this exhibit is a sensory organ, not part of the venom-injecting apparatus

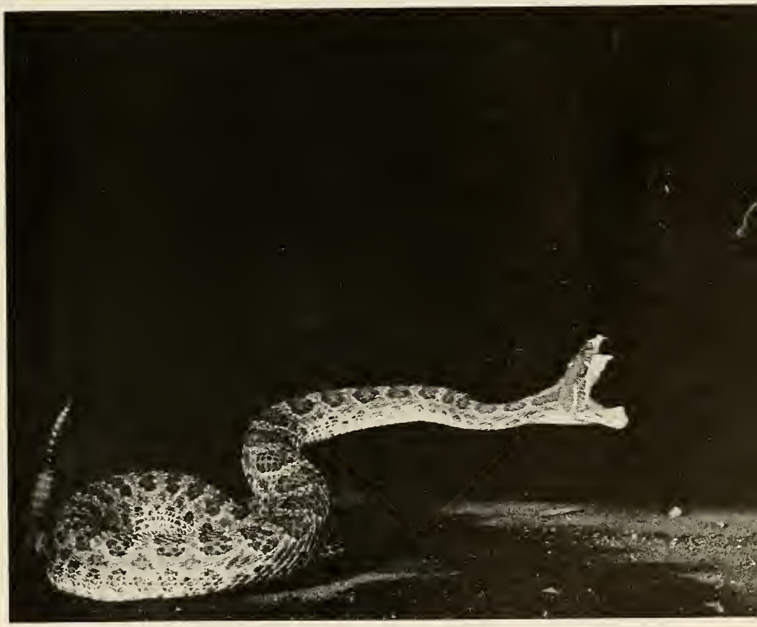
connected to one side of the trigger switch controlling the flash. The snake was placed on a pad of damp earth over a square of hardware cloth which was connected to the other side of the switch. Thus the first bare contact between the striking fangs and the balloon fired the flash.

To show the position of jaws and fangs at the moment the balloon burst, the switch points were fastened close together on the surface of the balloon in such a way that they would come into contact when the balloon collapsed. To get the action an instant later, with the withdrawal movement under way and the mouth closing, the switch points were handled in the same way but placed a little farther apart.

The withdrawal picture, which shows the return movement half completed while small pieces of the balloon are still in the air, gives some indication of the speed of the strike. It is incredibly fast. The first picture of the snake shows the long, black, forked tongue flicking out. This is often thought to be some sort of stinger, though in fact it is a highly useful sensory organ. What happens to the tongue when the snake strikes can be seen in the head-on picture, which shows the jaws wide open after the balloon has burst. The tongue is withdrawn into a protective sheath in the floor of the mouth. The black hole at the lower end of the lower jaw is the opening of this sheath.



▲ Head-on view at instant of collapse of balloon. Note small black hole near front of lower jaw, into which the tongue has disappeared



▲ Withdrawal after striking the target

How Dangerous ar

Hair-raising stories are written about the ferociousness of the tiger, the lion, and the bear, but the most dangerous animal of all may be lurking in your own cellar

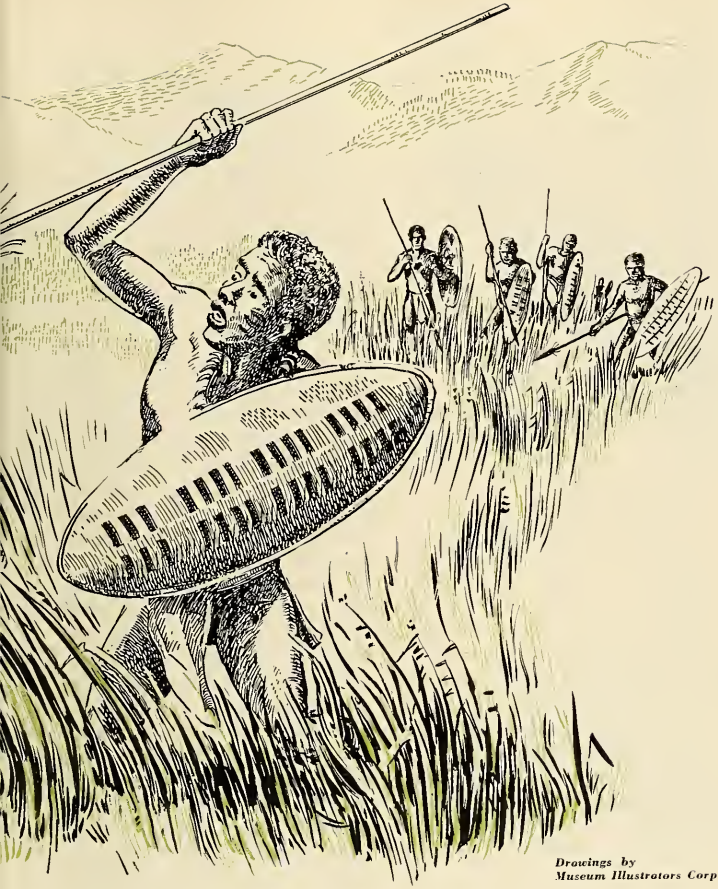
By George G. Goodwin

Associate Curator, Department of Mammals,
American Museum of Natural History

MOST animals of any size are dangerous to man, but fortunately for him they do not know it. Man has the advantage over the beasts of the field only in that he has armed himself with artificial weapons and protection. With few exceptions, animals are not aggressive toward man; the danger lies in their attempt to protect themselves from man.

As a protective measure a comparatively few species exercise collective armed might. The peccary is credited with combining forces to attack an aggressor, and a band of musk oxen will join together in a circle to protect all sides of their group from the onslaught of wolves, bears, or dogs. Honeybees and many of the social wasps will frequently attack in mass when someone threatens the safety of their nest. A stampeding herd of large animals is dangerous to anyone caught in its path, but the animals are fleeing from danger, not attacking.

Most animals and birds will fight to protect their young. The large carnivorous animals such as the big cats and bears are especially dangerous when they have cubs or kittens. Hawks will stoop at anyone climbing up to their eyries, and a goshawk will plough right in and severely claw anyone who gets too close to its young.



◄ Man-eating lions represent but a small percentage of the lion population. Most lions will run at the sight of man

Drawings by Museum Illustrators Corps

Animals?

All through the ages, man has been afraid of the dark and the unknown. Everyone has heard the legends of vampires—batlike creatures that are supposed to suck your blood under cover of darkness. These legends are of Old World origin, which is strange in light of the fact that the only bats that actually subsist on blood are restricted to tropical America. The true vampires lacerate the arteries of human beings while they sleep and lap up the flow of blood, but they are comparatively small bats, and the loss of blood is not serious.

Animals have entered many fields of protective and aggressive warfare. The most effective and useful weapon is usually found in the mouth. Many insects have horny cutters encasing the mouth and can inflict terrific punishment for their size. Most mammals will fight their way to freedom with their teeth. But some, such as the rabbits, will not bite no matter how badly they are treated; and a few, such as the anteaters, do not have teeth.

The cats have the most highly specialized teeth for attacking, but the dogs have the strongest jaws. Tusks, such as those of the elephant, walrus, wild boar, etc., are used primarily for obtaining food, but they make effective weapons none the less. Teeth are practically useless without a strong jaw to drive them in and the power to hold. The snakes are an exception; their needle-sharp teeth are directed backward in the mouth so that the victim is virtually hooked – the harder he tries to escape, the deeper the teeth penetrate. The poisonous snakes inject their venomous fluid through their long hollow fangs, and a struggling victim only increases the dose of venom. This death-dealing serum is only injurious when it enters the blood stream. The snake can eat its victim without ill effect.

Tarantulas, black widow spiders, and the like have poison sacs in the mouth and are able to inject their venom into a wound. Scorpions, bees, and wasps inject their poison by means of a fine horny stinger situated at the hind end of the body.

The mammals have entered the field of chemical warfare. Most animals of the weasel family have anal glands specialized for ejecting a disagreeable and irritating fluid. The skunks have carried this specialization to the extreme. They can eject their obnoxious fluid in the form of a fine spray and can hit a target eight or nine feet away with remarkable accuracy. The charge is usually directed at the face of the aggressor and is most effective when it comes in contact with the eyes, nose, and mouth. The bite of some shrews has a mild toxic effect but is harmless to anything larger than a mouse.

Nails, in the form of claws and hoofs, are effective weapons. Cats have especially sharp claws, which, when not in use, are retracted and kept in a sheath to guard their fine points. Most hoofed animals will fight with their sharp forefeet. Horses kick and are very adept at whirling around and dealing a broadside with both heels simultaneously. When cornered, a kangaroo can defend itself from a whole pack of hounds by means of a great claw on its hind foot. It will rip to ribbons any individual within its grasp.

Deer, oxen, sheep, and goats do not have upper teeth in the front of the mouth and cannot bite, but they have horns or antlers—in the male if not in both sexes. Horses, asses, and zebras, on the other hand, which have teeth in the front of both upper and lower jaws and therefore can and do bite, do not have horns or antlers. There is no doubt that in a head-on charge the antlers of the moose or elk present a more formidable front than the horns of a bison, but the antlers are only serviceable for about four months of the year, and only the male has them, except among reindeer or caribou. Horns, as distinct from antlers, are permanent appendages and are usually possessed by both sexes.

Dogs fight only with their teeth, but cats use claws as well. A bear goes one step further and crushes its victim with its arms. A grizzly can break the neck of an ox with one blow of its mighty paw. A big boa constrictor or python will strangle its victim by wrapping its body around it and contracting the coils. One of the large boas can crush a pig or small deer to pulp and swallow it whole.

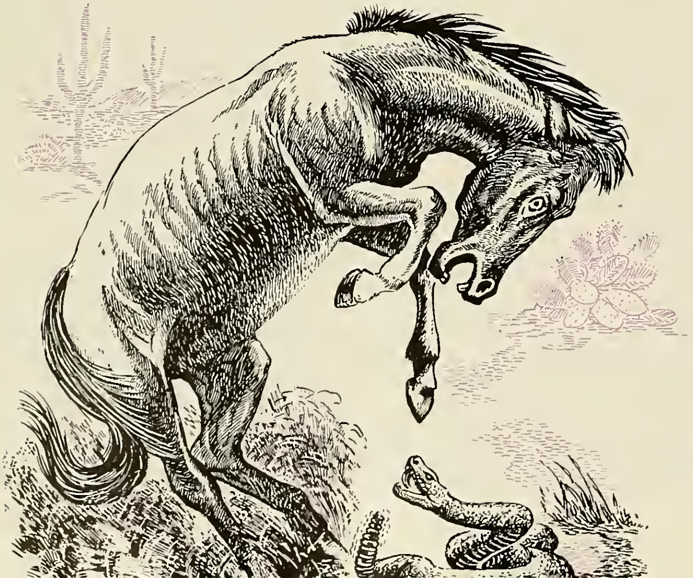
Most of the people who have accidents with animals are careless or inexperienced hunters. A few persons get badly mauled by wounded animals, but most of the deaths occur when a hunter mistakes another person for an animal.

With the reduction of working hours and more time for leisure, there is a marked tendency for the average American to go farther afield for his recreation. Extended vacation periods and swift transportation bring the quiet and peace of many great wildlife reservations within the reach of almost every citizen, and even central Africa is less than two days away from New York by plane.

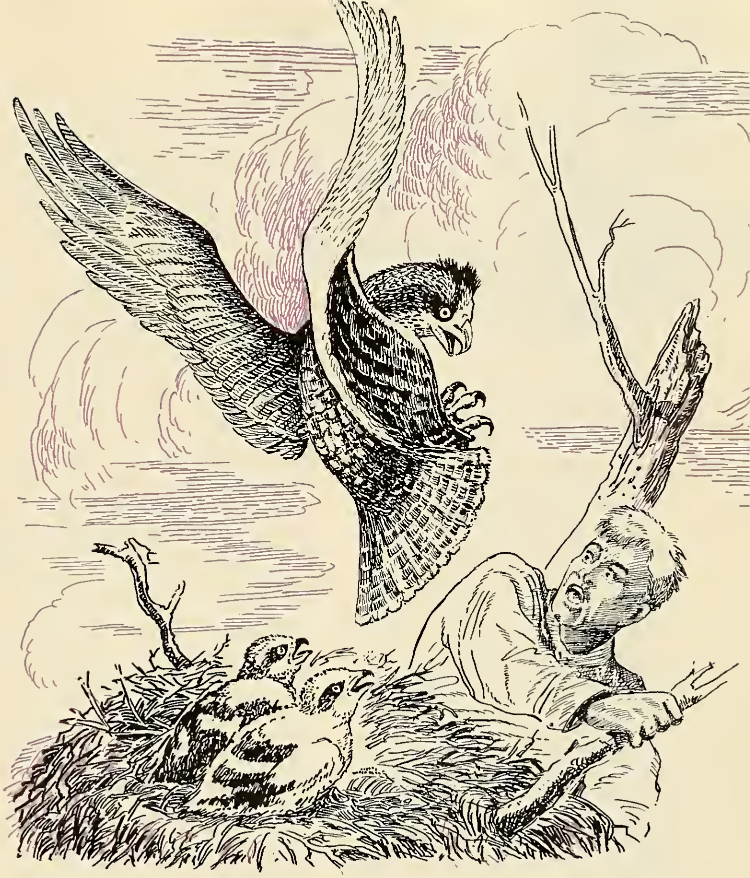
It is only natural that during these times of insecurity and unrest man should be instinctively drawn back to the cradle that raised him. Gone are the great herds of game from most of the world. Waving corn now sweeps over plains and prairies where once roamed the antelope and bison. An air of lonely silence hangs over the lofty mountain crags, the deep green woods, the still blue lakes. Occasionally a bear ambles out of the forest gloom, and the deer browse in remote woodland glades. These remnants of America's once great wildlife are forever on the alert, not so much for a natural foe but because they fear the presence of man. Even the scent of human beings borne on the breezes will send these creatures scurrying to safety. Most wild animals, great and small, have acquired a sincere respect for man. Even the grizzly bear, once America's most formidable creature of the wild, has learned to shun the hunter with his firearms. There was a time when all stepped aside for the grizzly; none disputed his lordly right. Today we are virtually safe from attack by *all* wild creatures, providing they are not provoked and we use reasonable discretion. Normally all the mighty beasts of the field flee at sight of man. In fact, unspoiled wild animals are much safer and more trustworthy than the domesticated creatures.

I do not know of a single authentic case in which a pack of American wolves has actually attacked a human being, and it is not improbable that most, if not all, of the tales of ferocious Russian wolves were based to a large extent on folklore and hearsay. Yet only recently, a pack of well-trained and cared-for bull terriers murderously attacked and killed a child for no apparent reason except perhaps out of sheer lust to kill. Everyone is familiar with the treacherous nature of the domestic bull. Many a farmer has been gored to death by a prize bull. Unprovoked attack cannot be charged in the same way against the wild bison.

It is true that every once in a while someone does get hurt by a wild animal. As might be expected, the public rises in wrathful indignation, demanding the creature's death. A life for a life may be poetic justice, but it is not fair to condemn a whole race because of the misdeed of one individual that has dared to attack man, the most ruthless of all killers. It was indeed a horrible tragedy when a black bear killed a three-year-old child in Michigan not long ago. Such a disaster naturally stirs deep



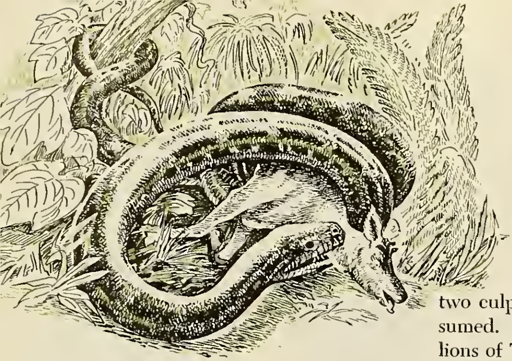
◄ Rattlesnakes are one of our most dreaded creatures. Horses as well as deer kill them on sight public feeling. Seemingly, there was no one to take the blame except the bear, and the chances are that the bear was not a really bad bear. At least, there was not sufficient evidence to accuse it of willful, premeditated murder. No criticism could be directed at the child's mother; she was used to seeing black bears around the house and to chasing the animals away with nothing more formidable than a broom. She was justified in her assumption that an untamed black bear would not attack without provocation. The animal is not a habitual meat eater but subsists principally on berries, nuts, roots, insects, and mice. Actual details of what happened, if they were available, might offer some explanation of this strange behavior. The child may have been eating candy and, as children are apt to do, smeared a liberal coating of sugar on her hands and face. The bear, being exceedingly partial to sweetmeats, may have carried the child off primarily for the sugar. Explanation will not bring back the child or soften the anguish of the parents. But somewhere along the line, human intervention had grievously erred in dealing with this particular bear.



▲ Most animals and birds, like the osprey shown here, will fight to protect their young, but man is the aggressor

Where man's respect for the mighty beast of the field has waned, trouble must follow sooner or later. Wild creatures may temporarily be subjugated to the human will, and they may seem unresentful or even grateful for a hand-out of choice food, but under such circumstances they cannot be trusted unconditionally. As soon as their desires are frustrated and their respect for man has been dispelled, anything can happen. It is not only the bear that will turn and attack the hand that feeds it. A buck, hand-raised from a fawn and bottle-fed, may be a most exemplary pet during its tender years, but on reaching maturity it may suddenly and without provocation or warning turn on its master and attack. It should be remembered that when cornered or suddenly confronted with danger, and especially when wounded, any wild animal is apt to charge. This is not a treacherous attempt to kill but an act of self-preservation. A rhinoceros will almost always charge when surprised at close quarters, but given a reasonable warning it will put as much distance as it can between itself and the intruder. African buffaloes and elephants are among the most dangerous animals to hunt, not because of any resentment they may bear toward man but because when wounded or cornered they have courage enough to charge in an attempt to save their own lives. Rogue elephants and elephants "in must" are an exception, although even here it is a mental disorder or expulsion from the herd that makes them dangerous. On the other hand, the elephant is one of the few wild animals that can be trusted when domesticated. In fact, as Mr. W. A. Bevan, a wild animal collector, aptly puts it, "Elephants are grand people." Madge Bellamy tells of an incident where the quick thinking of a trained elephant averted a tragedy. It seems that in her act an elephant was supposed to make the pretense of kneeling on Miss Bellamy. On one occasion the posture was prolonged a fraction too long for the muscles of the poor beast. Being unable to support itself longer, it began to sink lower, thus increasing the pressure on Miss Bellamy. Apparently realizing that it was hurting her and would soon crush her, the elephant wrapped its trunk around Miss Bellamy and pulled her to safety, at the same time dropping on its knees with a crash.

Man-eating tigers and lions are usually elderly individuals that



◄ A PYTHON takes a strangle hold on a deer, crushing it by contracting the coils of its body and anchoring its tail on a nearby tree

have lost most of their teeth and are no longer competent to catch wild game for themselves. But this is not always the case. With the exception of full-grown elephants, rhinoceroses, and hippopotamuses, there is no creature in Africa safe from attack by lions, man included. Accusations of man-eating, however, can only be levied against the individual and not against the species as a whole. Man-eaters represent but a small percentage of the lion population. Most lions will run at the sight of man. Lions undoubtedly have a great respect for man, and near human settlements they know full well that human flesh is taboo. Despite the fact that man is the easiest prey of all and can put up little resistance, lions never initiate the attack except under cover of darkness—the darker the night the greater the danger. In daylight there is practically no danger. The first offense is usually attributed to some unusual circumstance, but once having killed and having acquired the taste for human flesh, a lion will become a habitual man-eater. The reaction of the lion is parallel to that of the gambler who wins the first time and figures he has found a way to pick up easy money. A man-eater never devours its prey on the spot as it does other game but drags the victim away to the seclusion of the bush, as though aware that carelessness will defeat him in the end. The most notable man-eating lions were the two that actually held up the construction of the Uganda Railway in East Africa by repeatedly carrying off and devouring workmen. Eventually the engineer in charge, Mr. Patterson, killed the two culprits, and the work was resumed. These famous man-eating lions of Tsava are now mounted on exhibition at the Chicago Natural History Museum.

In southern Asia, tigers take a greater toll of human life than the lions in Africa, which is understandable since conditions are more favorable for them. In Asia, the native population is far denser than in Africa, and the jungles and tall grass close to the native villages provide cover for the tigers in their approach and retreat. As with the man-eating lions, it is only the occasional tiger that habitually preys on human beings. Reports of man-eating leopards are few and unsubstantiated, but a wounded leopard is an exceedingly dangerous animal.

Probably one of the best examples of what happens when uncontrolled animals have lost their respect for man is the wild dogs of the Ramapo Mountains, New Jersey. These dogs were descendants of domestic animals that had been left to forage for themselves. While they had sense enough to avoid closely populated communities and parties out to hunt them down, they would murderously attack an unarmed individual and sometimes treed a man for several days.

Then there are instances where visitors to zoological parks have disregarded signs and paid for their folly by the loss of an arm. The actions of caged animals are unpredictable, and anything thrust between the bars is acceptable as an offering of food.

For a while the bears in our national parks were encouraged to feed at hotel garbage dumps. This proved an interesting attraction for the tourists, but it was not long before the bears became uncontrollable. They ripped cars open in search of food and approached individual tourists to confiscate their lunch and candy. Fortunately, the park commissioners realized the potential danger and put a stop to unauthorized feeding of the animals.

It would be easy, of course, to call the malicious attacks of wild beasts on man a mystery of nature, but it is the business of natural scientists to find the immediate cause. In most, if not all, of the cases, the explanation is found in the definition of the word "wild." Wild, in the sense used for wild animals, means living in a state of nature unaided and without care of man. When animals are fed and cared for by man, they can no longer be classed as wild.

It is not always the inexperienced citizen that gets hurt by savage beasts. Experienced animal trainers and zoological park attendants are often badly mauled and occasionally killed by the animals in their care. The animal trainer who enters a cage of lions, tigers, or bears and makes them perform must be endowed with unfaltering determination and courage. He must not only keep his will dominant but must be able to predetermine the action of each animal. An indication of hesitation or fear would be fatal to the trainer. Only recently in California Miss Grace O. Wiley, an expert in handling venomous snakes, paid with her life for miscalculating the actions of a captive Sumatra cobra. Some unforeseen circumstance caused the snake to strike and sink its fangs into Miss Wiley's finger. She died 90 minutes later.

Poisonous snakes take a large toll of life in warm and tropical countries, but only a large python or boa constrictor would kill a man for food. Alligators and crocodiles are responsible for a few human casualties.

There are instances where fish have become habitual killers as a direct result of man's intervention in their scheme of things. In the West Indies, where the refuse from slaughterhouses is dumped into the ocean, barracudas congregate to feed and have acquired a lust for red meat. So ferocious have these creatures become that it is not safe to bathe on any of the neighboring beaches. On more than one occasion, bathers have been viciously attacked by barracudas and literally torn to pieces by their rows of long spiked teeth before rescuers could reach them.

If you put your foot into one of the giant clams found in certain tropical waters, it will snap shut and hold like a vise, and you may be drowned before help arrives. Divers sometimes encounter octopuses, but the big and dangerous ones are usually in deep water.

On the other hand, dolphins apparently have been instrumental in saving the life of drowning persons by edging them onto the beach.

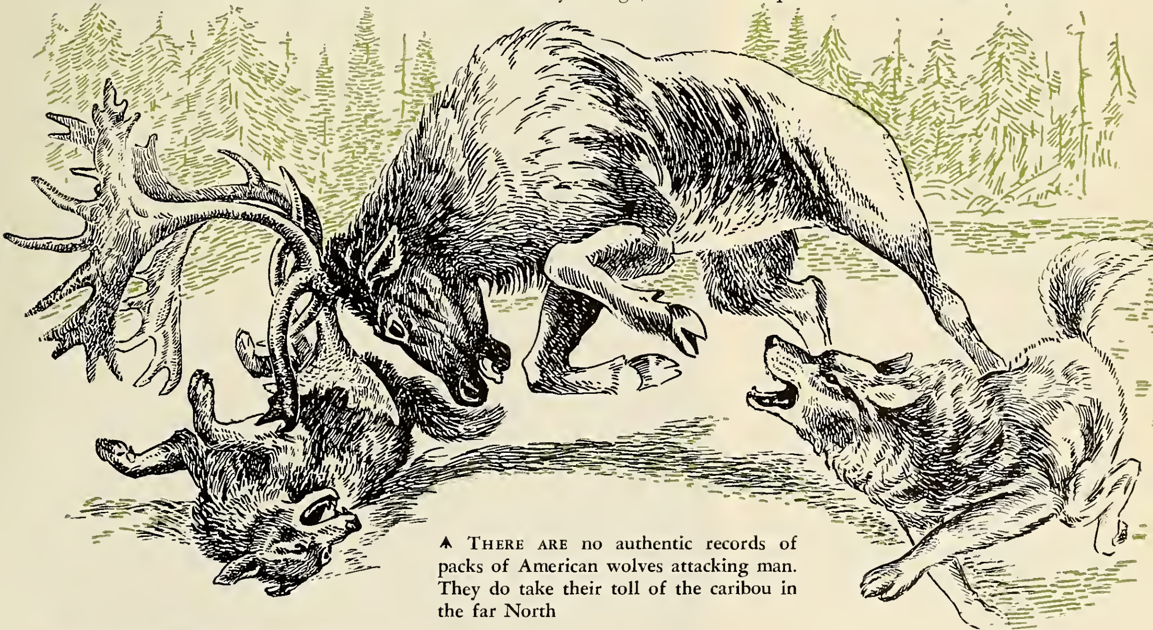
A summary of the principal cases in which so-called wild animals have attacked human beings shows that in most instances the animals have been spoiled by human kindness. Spoiled animals, like spoiled children, will take advantage of liberties extended to them.

Lions and tigers are among the most dangerous animals, and the African buffalo is in some ways even more formidable to hunt. But in answer to the question, "What is the most dangerous animal?" we must look elsewhere. There is a smaller creature that has taken a greater toll of human life than all the other forms of wildlife taken together. It is the rat. Even today, rats exact an enormous tribute each year, and everyone pays dearly for their support. In the war against rats, man has fought a losing battle; the hordes of pestilence carriers are on the increase. In well-governed lands, science has curbed the spread of disease by isolation and innoculation, but once a plague leaks out, the rats are there ready to carry it from city to city and from town to village. Most wild creatures serve some useful purpose, but this can hardly be said of the house rat, unless you argue that overpopulation is a menace to the human race. Unrestricted as an agent for spreading diseases, rats can and have in the past reduced the world's population faster than any other agent, including war. Hitler, with all his machines for destroying life, never approached the awful havoc meted out by rats.

Man is a born hunter, and if he goes looking for them, he will meet the large and dangerous animals. Although hunting is considered a social achievement in some classes, it is one of man's most primitive characteristics. There are those who shrink at the very thought of taking the life of any creature but, cut off from the supply of prepared food, even the timid soul will revert to the primitive instinct and hunt for food.

From the very beginning there has been a struggle between man's kindly nature and his desire to kill. When a child comes in close contact with a potential victim, a kindred feeling for the creature is quickly established, and he will endeavor to protect rather than harm it. Normal children are apt to try to restore life to a victim that they themselves have killed. Given a weapon, be it a stone, stick, or gun, the hunting instinct in a boy quickly dominates his kindly nature, and his sensitive feelings may not be hurt by seeing the victim suffer. With a gun in his hand he has a feeling of power; his ego is bolstered, and he can display his skill.

In developing the ability to reason, man shouldered the responsibility of curtailing suffering. Physical pain is a forerunner of death and is felt by all creatures. It is the first and most vital asset in the preservation of life. When you understand this, you will understand much in the behavior of animals, and you may be less inclined to provoke a wild animal to action.



▲ There are no authentic records of packs of American wolves attacking man. They do take their toll of the caribou in the far North

This unique photographic telescope is being used in one of the greatest projects in modern astronomy — compilation of the first atlas of the heavens

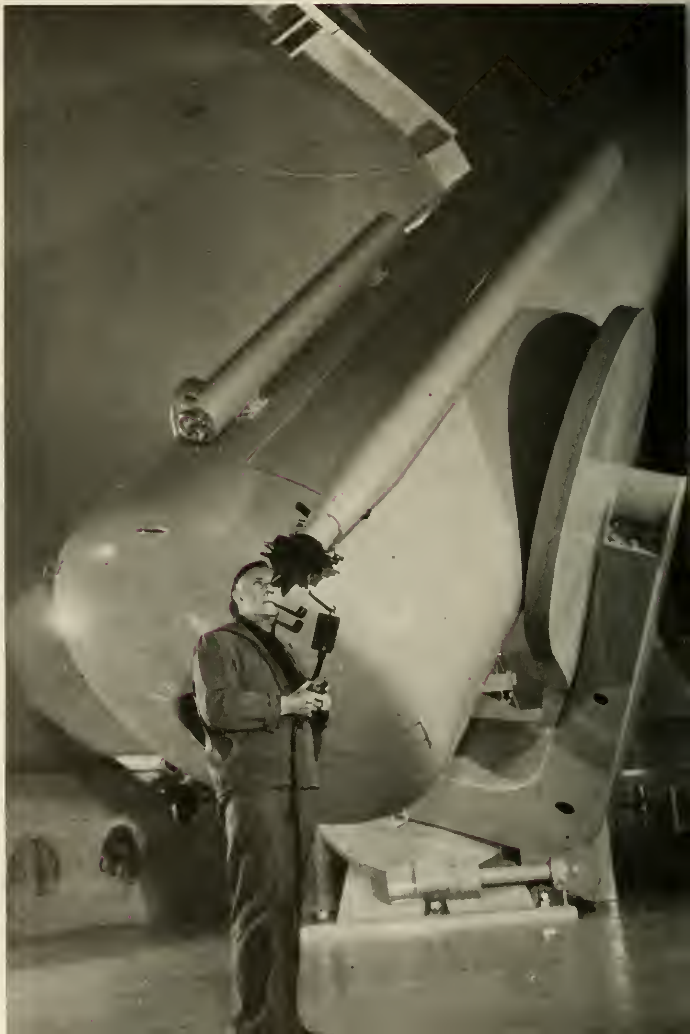
By
ROBERT R. COLES
Associate Curator, Hayden Planetarium, American Museum of Natural History

"Big Schmidt"

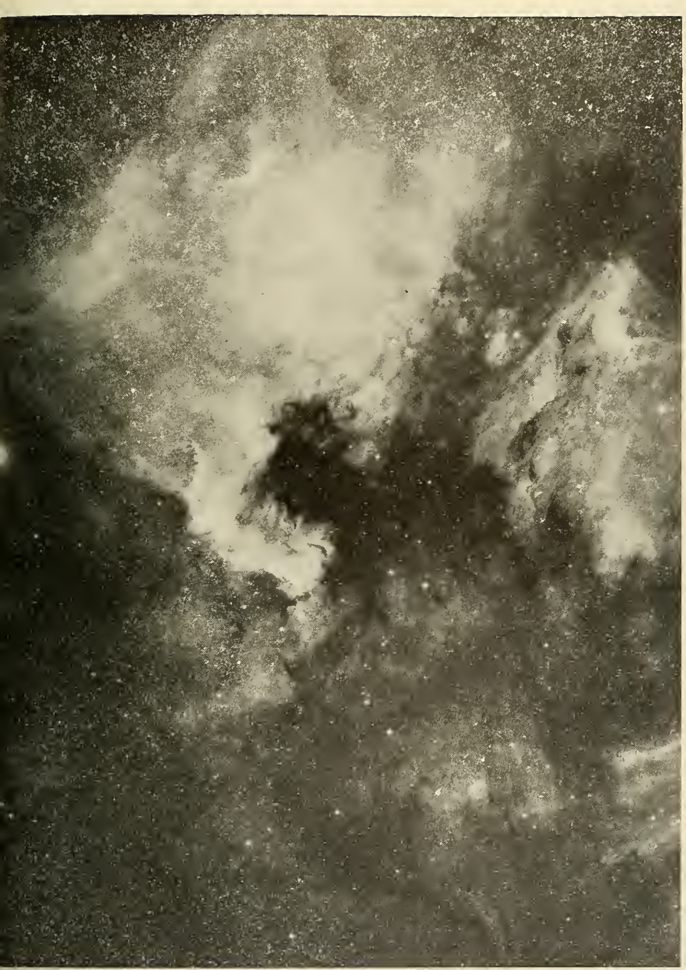
Little Giant of Palomar

ALL day Tuesday, July 19, 1949, astronomers on Palomar Mountain watched the heavens with more than casual interest. They were hoping for a clear night with good seeing. Fortunately, their hopes were fulfilled. It turned out to be one of those tranquil summer evenings that delight the hearts of the star doctors. The deepening sky became a canopy of velvet in which the brighter stars sparkled like gems. As the final afterglow of twilight faded into the full dark of night, the entire heavens blossomed like a beautiful celestial garden.

It was in this perfect setting that one of the greatest projects in modern astronomy was launched—the National Geographic-Palomar Observatory Sky Survey. The work began with the taking of two photographs of a particularly interesting region of the heavens in the constellation of Cygnus, the Swan. The center of interest in these pictures was the famous North America Nebula, a mass of stars and gaseous interstellar matter that bears a striking resemblance to the continent of North America.



➤ DR. EDWIN P. HUBBLE, dean of American astronomers, directing the final rehearsal of the 48-inch Schmidt for its exhaustive survey of the sky. Teammate of the 200-inch Hale, this unique telescope has already begun to reveal new and startling facts about our solar system



▲ THE FIRST PHOTOGRAPH taken by the Schmidt of the famous North America Nebula, so-named because it bears a striking resemblance to the continent of North America. The Schmidt phototelescope will in four years complete a survey that would take the 200-inch telescope 5000 years

The object of this program is the compilation of a new star atlas that will include the heavens visible from Palomar Mountain. From that latitude, three-fourths of the heavens surrounding the earth can be photographed with accuracy. About ten per cent more, a so-called "fringe area," can be covered in some degree but not as sharply as the rest. A supplementary survey will be necessary to obtain this fringe area with the desired accuracy, and the remaining fifteen per cent that is out of reach far down in the southern hemisphere. It will involve the making of several thousand photographs on plates measuring 14 by 14 inches, each covering an area of the sky about 7 degrees square. When completed, there will be 20 large volumes, and the atlas will be made available to observatories at cost. It is estimated that the price of each atlas will be about $2,000.

Surprising as it may seem, this work is not being done with the much-heralded 200-inch giant eye of Palomar but with a smaller instrument known as the Schmidt telescope. There are two of these on Palomar Mountain, used in conjunction with the larger reflector. One, called the 18-inch Schmidt, has been in successful operation for several years. Its companion, the 48-inch Schmidt, which was completed last year, is now being employed in the present survey.

To the casual visitor this telescope resembles a huge cannon more than anything else. It looks like something out of an H. G. Wells novel. In reality, it is one of the greatest marvels of modern precision engineering. Its basic design is quite like that of any other reflecting telescope, with a large mirror to capture the light messages from the stars. But there are several small but important differences. These include a different shape for the big mirror—spherical in the Schmidt telescope instead of parabolic. The addition of a specially-designed correcting lens at the center of curvature of the large mirror plus other modifications make it very much better suited for photographic survey work than any other type of telescope, including the 200-inch reflector. The latter, despite its ability to penetrate a billion light-years of space, can photograph only a very limited area without distortion. The Schmidt phototelescope will complete this job in about four years. The "Big Eye" would take 5000 years.

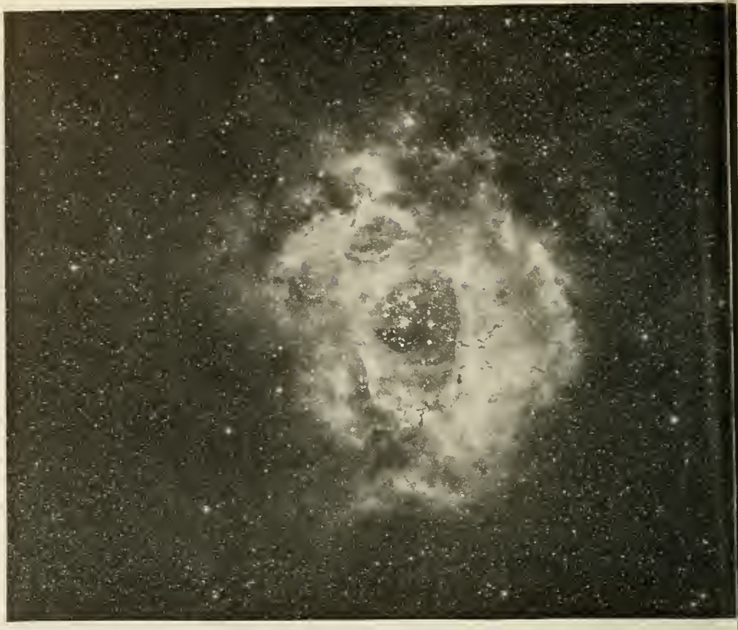
Because of its unique design, the 48-inch Schmidt will photograph a much larger area with almost perfect definition to the edge of the plate. And while the large Schmidt telescope cannot reach as far into space as the 200-inch reflector, it still has a penetrating power of 300 million light-years!

Another surprising fact about the Schmidt instrument is that it cannot be used for direct visual observation. This is because of the way it is built. It is impossible for the observer to get his eye in position to observe the image reflected by the large mirror. In place of the eye, a photographic plate is held in that position to receive and record the image. Being exclusively a photographic device, it is often referred to as the "Schmidt Camera." It is equipped with two 10-inch refracting telescopes for guiding. These are mounted on opposite sides of the barrel so that one is always accessible from the floor, where the astronomer works.

The Schmidt camera was invented about 20 years ago by Bernard Schmidt, an associate at the Hamburg Observatory in Germany. But this unadorned statement ignores the most fascinating part of the story, which focuses on the unique personality of the man whose dreams and endeavors came to fruition with the completion of this remarkable instrument. The story really begins some 70 years ago, with the creation of a lens from the round bottom of a broken bottle by a lad in an Estonian Island village. Young Bernard Schmidt was the eccentric son of a German father and a Swiss mother. Even then, young Bernard was different from other children. Friends and neighbors thought him queer because of his shy manner and the insatiable curiosity that, indeed, on one occasion almost cost him his young life. At ten, Bernard became interested in explosives and one day set out to build a bomb that would produce a tremendous noise. After packing a quantity of powder into an iron pipe, he attached an improvised detonator. Just as his experiment seemed to be progressing successfully, there was a terrible explosion. The bomb went off too soon—and young Bernard lost one of his arms.

Had it not been for this accident, astronomers of today might be without the Schmidt camera, for the budding scientist directed his attention away from explosives and into the less dangerous avenue of optics.

His utter lack of equipment and funds did not deter him in the least. It was only a year or so later that he fashioned the crude lens from the bottle glass by grinding it in a saucer of sand. Later, upon hearing of the new process called photography, he built a simple camera out of an old cigar box and began to experiment with the film then available. In these two projects can be recognized the root of the great instruments that today bear his name.



▲ **ENLARGEMENT** of a small section of a test-run photo made by the "Big Schmidt," showing a portion of the Milky Way in the constellation of Monoceros. This nebula is actually a cloud of dust and gas illuminated by near-by stars

From those early formative years, Schmidt's major interest was optics, and when ready for higher education he sought expert instruction in Sweden and later at a technical school near Jena, the famous optical center in Germany. After that he began experiments on his own and ground his first professional telescope mirrors. It was a hand-to-mouth existence, but he eventually became associated with the Hamburg Observatory. It is reported that he was a most unusual man—an individualist of the first order. Among other eccentricities was his habit of working in a claw-hammer cutaway coat and striped trousers. Little interested in money, he rejected several remunerative positions in favor of work more in line with his special interests. His colleagues recall how they often saw him pacing absent-mindedly about the streets of Bergdorf, a suburb of Hamburg, with his hat pulled down and his cigar tilted up so that it seemed his hat brim might be ignited at any moment.

This shy, retiring genius, who coveted independence above all else, was the man to whom the astronomers turned in the 1920's for the solution to one of their most technical and perplexing problems.

At that time it was impossible to take telescopic photographs that were clear and sharp over the entire negative. Several theories for solving this problem were submitted to Schmidt, but none of them seemed to him practical. In 1926, he announced his ideas for a solution, but they were not favorably received. He said no more but refused to be defeated. Three years later he was crossing the Indian Ocean, en route to the Philippines on a German eclipse expedition. With him was Dr. Walter Baade, of the Hamburg Observatory. In the course of a conversation, Schmidt mentioned that he had worked out the solution for the "perfect mirror." He proceeded to explain the principle upon which it should be designed.

Dr. Baade enthusiastically suggested that Schmidt should build one on his return. But it was not until the summer of 1930 that he completed his first test instrument, a 14-inch model. One Sunday afternoon he invited Dr. Baade to witness a demonstration of his revolutionary phototelescope. From an attic window, he trained it on a cemetery some distance away. Dr. Baade peered into the eyepiece.

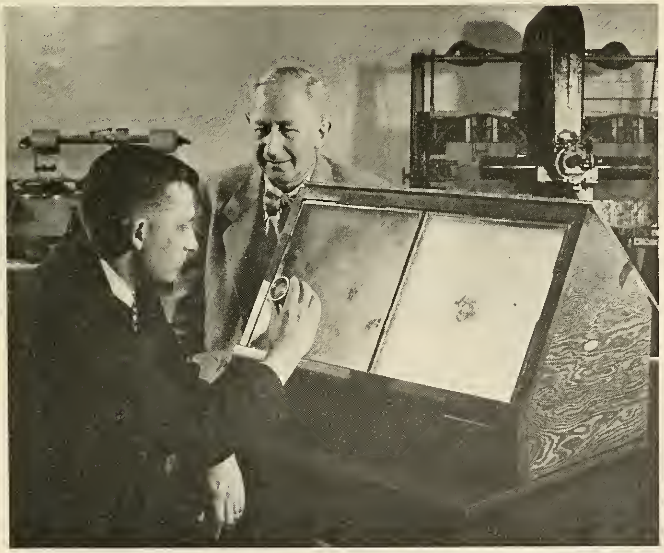
"Can you read the names on the tombstones?" Schmidt asked.

"Yes," came Baade's elated reply. "But I can really see only one thing—the optics are absolutely marvelous!"

Astronomers were skeptical of the possibilities, however, and real progress was not made until Dr. Baade presented the idea to the astronomers at Mt. Wilson, California, in 1931. Bernard Schmidt died in 1935 without knowing whether his dream would ever be translated from blueprints to reality.

Already the 48-inch Schmidt has proved it superiority in the field of survey work. It made astronomical history last summer when it captured the image of a previously unknown asteroid, or minor planet, which moves nearer the sun than any other known body except a comet. At times this object, which is probably less than a mile in diameter, approaches to within 22 million miles of the sun. Further study of its behavior may shed light on the evolution of the solar system and will perhaps aid astronomers in more accurately determining the mass of Mercury.

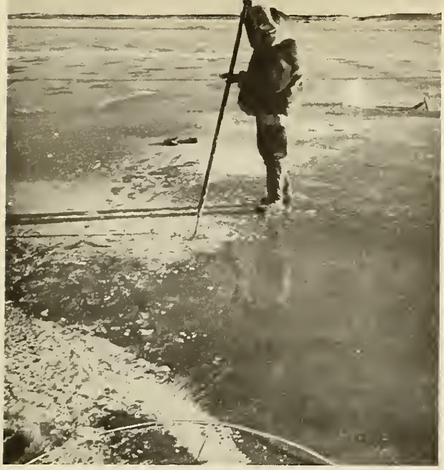
In this survey two exposures are being made in every region of the sky covered. One of these is on film sensitive to red light, the other on film sensitive to blue. In many instances the two exposures reveal very different pictures. This is because some stars radiate a predominance of red light while others show more of the blue. Another advantage of the red-sensitive film is that it is more efficient than the blue in penetrating the haze that is so pronounced in some regions of interstellar space. This is particularly dense in the region of the Milky Way.



▲ Sky survey experts: Dr. Albert G. Wilson (*left*), key astronomer in the project, checks over some test negatives, while Dr. Walter Baade, close associate of the inventor of the "Big Schmidt," looks on

While it is impossible to list all of the benefits of such a survey at the present time, a number of them are quite obvious. Estimates indicate that the survey will record a total of some 5000 million stars and perhaps 10 million stellar systems beyond our galaxy. It will serve primarily as a patrol camera for the larger 200-inch telescope. In addition, the atlas will be a useful research guide for many other observatories in the United States and abroad. It will undoubtedly add to our knowledge of the architecture and dimensions of our own galaxy and provide a more complete census of the various types of objects it contains. It should also yield valuable information on the distribution and density of matter in interstellar space and perhaps offer a clue to the origin of the stars. In the past, these nebulous clouds have proved very annoying to the astronomer by hiding much of the cosmos. The use of red-sensitive film will carry our sight farther into these mysterious depths of space. At the same time, the survey will reveal important facts about the distribution of thousands of galaxies of stars (the so-called island universes) beyond the outposts of our own stellar system. Thus it should provide a better understanding of the over-all structure of the cosmos. Last summer's discovery of the new asteroid shows that the camera is already on its way to revealing new and startling facts about our own "little" corner of space—the solar system.

The possibilities that lie ahead in this great undertaking are truly startling. It will certainly reveal scores of celestial marvels as yet unknown to the most learned astronomers. Quite possibly the discoveries of the 48-inch Schmidt during the next four years will overshadow anything that may come from the more publicized 200-inch Hale reflector. Certainly it will more than justify its name — the Little Giant of Palomar.



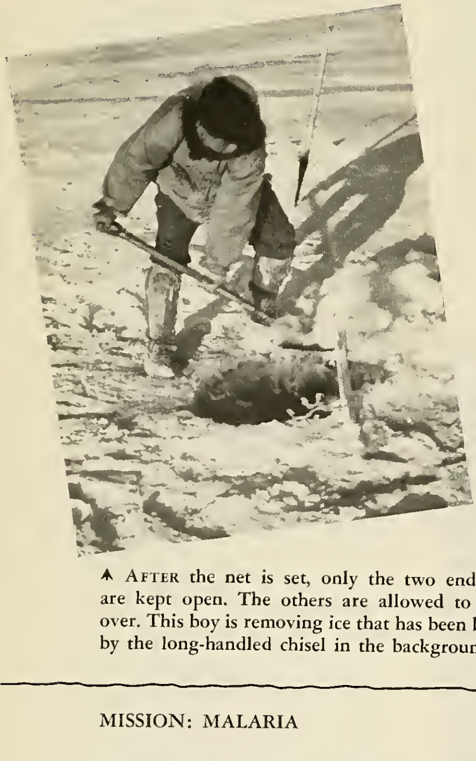
▲ SEVERAL HOLES about fifteen feet apart are chopped in the ice. Then a line is threaded beneath the ice by means of a long pole, and a net is drawn through and fastened at the two end holes

Fishing under the ice

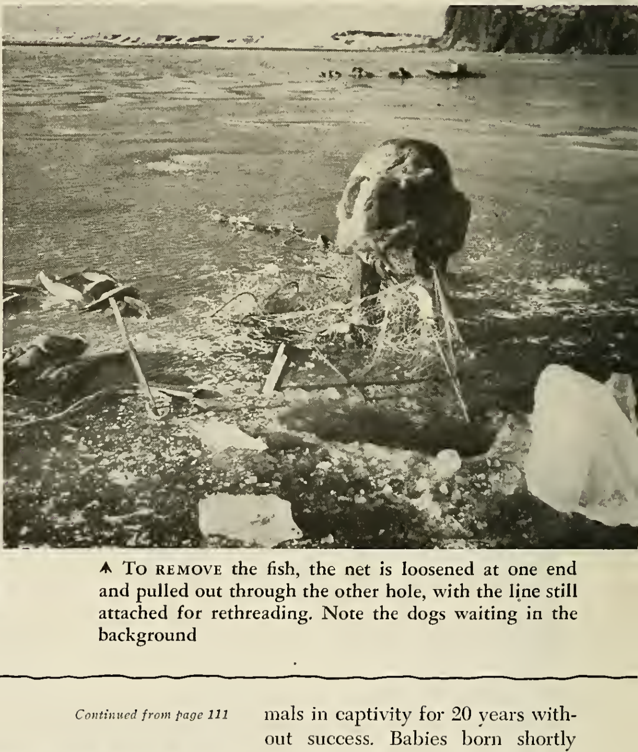
An unbroken expanse of ice does not prevent the wily Eskimo from harvesting the bounty of the sea

By THE REV. CANON J. H. WEBSTER
St. Andrew's Mission, Coppermine, N. W. T.

Photographs by the author



▲ AFTER the net is set, only the two end holes are kept open. The others are allowed to freeze over. This boy is removing ice that has been broken by the long-handled chisel in the background



▲ TO REMOVE the fish, the net is loosened at one end and pulled out through the other hole, with the line still attached for rethreading. Note the dogs waiting in the background

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MISSION: MALARIA

Continued from page 111

the same cage with a different partner, it showed little concern. However, if we put one in a different cage, either with the same or with a new mate, it dashed about wildly before settling down. Apparently remaining in the same cage was of more importance to the animals than remaining with same partner.

Naturally we had hoped that our caged pairs would eventually present us with elephant shrewlets, but we hoped in vain and saw no signs of mating. Later we learned that a South African embryologist had been attempting to raise these animals in captivity for 20 years without success. Babies born shortly after capture were destroyed by their mothers, but some brought in along with the females were nursed and carefully attended. One or two young are born at a time. They are quite like the adults except for scattered long black hairs in the coat.

◂ CHILLY WORK with bare hands, but well worth it. In some parts of the Arctic, seals are caught similarly in nets set around the breathing hole to which the seal must come periodically for air

▾ ICEBOX: a storage bin made of slabs of ice sealed together with slushy snow, which will keep the fish safe from prowling animals

Fear among elephant shrews is expressed by low screams, excitement and warning by a rapid and surprisingly loud rapping with one hind foot. Four shrews, two males and two females, bit us consistently when we handled them, but none of the other hundred did.

We found no fleas or lice in their fur but many small ticks. Tapeworms and nematodes were common in their digestive tracts.

At the same time that we were domesticating our animals we were studying hundreds of samples of their blood. The malaria looked surprisingly like human malaria but lacked those important asexual stages that keep the infection alive in the blood without further innoculation by the insect. Periodic examination of the blood, often at six-hour intervals day and night, failed to disclose these stages.

We were still perplexed over this strange phenomenon when the time came to fly the animals back to Dr. Huff at the Naval Medical Research Institute. Another worrisome time came then, for I was sent to Nairobi for an operation, and Chief Lawless was left alone with our "patients." The next day the rest of the naval party returned to Juba and helped Lawless prepare the elephant shrews for shipment in light metal cages that we had ordered from Nairobi. Commander Ruebush was assigned to head the party back, and he and Lawless recaged the first lot of elephant shrews ever to be sent to the United States. A few days later, when the big Navy plane had taken them across the Atlantic and settled down at the Washington National Airport, the animals were, I am told, more fit than their keepers. All of the 104 elephant shrews that we had started taming a month earlier arrived safely.

Even after extensive work on the parasite of the elephant shrew, Dr. Huff now finds some of the main problems unsolved. His original demand for a laboratory mammal with a type of malaria similar to man's has not been satisfied by the elephant shrew. Aside from the difficulties of keeping the animal alive and the apparent impossibility of raising a colony in the laboratory, no way is as yet known for transferring the infection experimentally from shrew to shrew.

But the disease does suggest a host of problems that it is important to solve at this stage of malaria research. We made another short trip to the southern Sudan during 1948 to investigate further elephant shrew malaria and other blood diseases of the wild animals there; but that is an unfinished story. As this is published, we are in the midst of a three-year tour of African duty for the Navy, and our first assignment is to try to fill in the many gaps in our knowledge of elephant shrew malaria.

BOOKS

Continued from page 103

inherent in such power, partly, he suggests, because civilization as a whole was still firmly rooted in a Christian ethic that could govern the use to which it might be put. But also, it seems, because the potential then available was still far from carrying the destructive force which modern science can place in ruthless hands. When one of the great physicists declares that no knowledge is better than modern science in the service of the irresponsible, we have reached a stage that is nothing less than critical.

Dr. von Weizsäcker in his *The History of Nature* has faced this transcendent problem of our time by writing a book on the essence of nature including man. He bridges the gaps created by our extreme specialization and lays before the reader a masterly summation of the historic course of nature, spanning the origin and structure of the universe on the one hand and the nature of man and his soul on the other.

The emergence of human consciousness and of a soul become in Dr. von Weizsäcker's history the culmination of a long series of events which alone can make their uniqueness understandable. It is only in the soul that hope for the future can be found. Knowledge with love is mankind's salvation.

This is a deeply moving book based on a broad erudition, simple in outline, profound in its insights.

Harry L. Shapiro

AMERICAN HEARTWOOD

----By Donald Culross Peattie

Houghton Mifflin, $3.50
307 pp., 19 woodcuts

A NEW book by Donald Culross Peattie will be hailed by all American naturalists. The present volume, however, is a series of 19 episodes from the "heart" of American history, written against the background of its exploited woods. The 19 chapters (whose subjects are well veiled in their literary titles) take one from Erik the Red through the boom and bust of the Comstock Lode. Each isolated narrative is told with authoritative detail, with the color and atmosphere of its times, in a style that is as graceful as it is fluent and with an imagination that adds immeasurably to its vividness. It is Peattie the historian who speaks more than Peattie the naturalist. Although many tales start and end at his California garden home with reflections worthy of John Burroughs, in others the naturalist may be obscured.

Peattie the historian—or perhaps, the patriot—assumes a new stature in this volume. He believes firmly, devoutly, almost simply, in the inherent greatness and goodness of America. Superlatives abound, directed always toward our democracy, our freedom, our abundance, our way of life. Of the rest of the world, he says little or nothing. If he must mention a few stains in our history, it is only to glorify our deeds of erasing them. As an historian, he looks backward, not at the present or forward. The problems of our economists today and the deep concerns of such conservationists as Osborn and Vogt are incompatible with his sense of American perfection. Nor is he a lover of the primitive wilderness, either for sentiment or for science. The disappearance of the passenger pigeon and the bison go not only unlamented but even as praiseworthy because way is made for farms and fences, wheat and clover, of his greater America.

Frank E. Egler

LETTERS

Continued from page 98

ground was literally covered with tiny baby frogs. He dismounted and, upon examination, found them very active, uniform, and about the size of a large horsefly. The wagon ruts in the old logging road he was traveling were filled with them. It was really impossible to avoid tramping on them.

Where could these frogs have come from? Buzzle and Trowl creeks were fed by the winter's snow and by springs and therefore went dry in the summer. Marble Creek was over the rise of the hills and mountains. The St. Joe River was at least sixteen miles away.

The baby frogs came with the rain, but from where? Is there some simple explanation for this apparently baffling occurrence?

Mrs. Rena Collins Fairfield
Spokane, Wash.

The following comments are offered by Mr. C. M. Bogert of the American Museum's Department of Amphibians and Reptiles:

In referring to "frogs," Mrs. Fairfield is using the correct name for all tailless amphibians, but the creatures her husband saw were undoubtedly toads in the popular sense of the word. Few frogs wander far from water, whereas the toads, once they have graduated from the tadpole stage, are principally land dwellers.

The appearance of hordes of small toads following a rain is not uncommon in arid portions of the United States. In Idaho those seen may have been either the Rocky Mountain Toad (*Bufo w. woodhousii*) or the Northwestern Toad (*B. b. boreas*). Farther south in the deserts one occasionally sees similar swarms of the Colorado River Toad (*B. alvarius*) or the Desert Toad (*B. punctatus*).

The explanation is relatively simple. Toads deposit their eggs in pools, usually in the spring, but in arid regions deposition must await the rainy season as well as suitably high temperatures. Seepages or springs, some of them temporary, provide sufficient water to permit toads to carry out their breeding activities. Pools in almost any situation are utilized. Even relatively tiny pockets along rocky cliffs often contain the characteristically black tadpoles, which emerge from the egg within two or three days after deposition.

The tadpoles are dependent upon plants such as the green algae or "pond scum" as well as upon small animals that appear in the pools soon after they are formed. The tadpoles of some toads are able to dispense with their gills within a month and a half, meanwhile having acquired legs as well as lungs that leave them free to emerge and hop about on the land. They are ordinarily most active at night, and the young may spread out in all directions from the isolated breeding points. To avoid the dry surface, they first seek shelter near the natal pool in rodent burrows, under rocks, or in any sort of crevice where some moisture is retained. Migration from the breeding site, where the available insect food of the transformed young can scarcely support many toads, is restricted until the advent of additional rain. Thereupon, the young toads come out from their moist places of concealment and continue their journeys, sometimes all of them in one area heading in the same direction. In most instances we can do little more than guess concerning the stimulus that directs the migration, however.

Doubtless many young toads are killed before the rain subsides and once more forces them to locate suitable shelter. A more or less permanent abode is finally established from which the toad emerges to feed whenever there is sufficient humidity in the air at ground level. No actual pool is necessary because the toad is able to absorb water from the moist earth that surrounds it in its chosen sanctum. The desert toad, an inhabitant of dry canyons, possesses a flattened body that presumably enables it to find suitable crevices with greater ease. In the Grand Canyon, for example, rains bring it forth in great numbers. Otherwise it is rarely encountered, although I once looked beneath an oak keg placed under a trickle from the rocks in Bright Angel Creek and found over two dozen toads solidly packed beneath the moist wooden bottom.

Dubious as it seems from superficial appearances, moisture is present not far below the surface in many desert regions. Ordinarily, to be sure, there is not enough

Photo by Gladys Diesing

▲ CYPRESS AND THE SEA. Flattened and twisted by the continual buffeting of the wind from the sea, the Monterey Cypress (*Cupressus macrocarpa*) grows in its natural state only in a limited area a few hundred feet from the ocean. This picture was taken on the Seventeen-Mile Drive which makes a circle of the Monterey Peninsula from Monterey to Carmel, California

to flow into an excavation. Nonetheless, in the large dunes not far south of El Paso in Chihuahua, I once followed the example of the local coyotes, whose excavations I could see, and found that murky but quite palatable water was available scarcely more than a foot below the surface. Sufficient moisture was present on the surface in the depressions between the dunes to satisfy the needs of a toad, with its absorbent skin.

Thus toads manage to survive in portions of the desert where the mean annual rainfall is no more than three inches. Indeed, on the only occasion when I crossed the extremely arid section between Gila Bend and the Colorado River during a night rain, several toads were seen along the highway. Where they had found enough water to breed I could only guess, but it was a fair assumption that if I had searched the region at the right time, I might well have found the young migrating from one of the few breeding sites that must exist in the region. How far they travel no one knows, but at times it must be a matter of miles.

The sudden appearance of swarms of toads following thundershowers has given rise to the myth, widely believed in many parts of the world, that it "rains toads." Indeed, a violent updraft accompanying a thunderstorm might occasionally carry a few small toads upward and drop them at a distance. So the myth may have this much foundation to strengthen it, but ordinarily the great numbers of toads that appear after rainfall in arid regions have come from their places of seclusion in the ground—not from the sky!

Kiwis from Way Back

SIRS:

I was very much interested in reading in the February issue of NATURAL HISTORY the article concerning the Kiwi. It might interest you to know that this name was used for the ground forces in the U. S. Army Flying Service during the First World War. My brother was in Army Aviation some time in 1917 until the middle of 1919. During his period of service, I heard him use this phrase to designate aviation ground troops on more than one occasion. He said that this was quite common in the service, although the soldiers did not seem to know whether the bird was from Australia or New Zealand. They knew very little about it, except that it could not fly.

ALFRED W. GALE

Troy, N. Y.

▲ An "usher" at the opening of spring: the wood frog (*Rana sylvatica sylvatica*) wears a distinguishing black mask about the eye

Belted Kingfisher

Sirs:

At your convenience, I would appreciate your comments on the following:

On Dec. 12, 1949, I saw a Belted Kingfisher feeding while on wing from the water in a creek near my home. There was broken ice in the water, as the temperature had reached three degrees above zero two days previous.

Reference books I've checked say this species winters in southern United States. Inasmuch as I've never heard of these birds being seen hereabout at this season of the year, I'm curious to know if this is an unusual occurrence.

William A. Breen

Troy, N. Y.

The following comments are offered by Mr. C. K. Nichols of the American Museum's Bird Department:

Although the Belted Kingfisher is recognized as a migrant bird in the northeastern part of the United States, it is true that some individuals will remain throughout the winter if there is open water with food in the vicinity.

In southern New York and in northern New Jersey, a few may be found every winter unless the weather has been very severe and the streams completely icebound. It must be a rare occurrence for a kingfisher to winter in the vicinity of Troy, for it is probable that its opportunity to find food in that latitude is rather slight. But this has been an unusually mild winter, and the feeding conditions in your vicinity have not been too difficult.

Do Crickets Damage Clothes?

Sirs:

Your article on the clothes moth was most valuable and has saved much time and energy. . . . I would now like to ask whether there is anything in a belief here in the Rio Grande Valley that our crickets eat wool. People chastise me for allowing them to remain in my house.

Gladys H. Osborne, M.D.

Harlingen, Tex.

The following answer to this question is offered by Dr. C. H. Curran of the American Museum's Department of Insects and Spiders:

In normal outdoor conditions, crickets are vegetarians, but when they enter warm buildings, they are liable to change their habits, and they may then damage woolens, cottons, and silks. The damage usually results from the presence of foreign substances on these materials. Grease spots or stains will attract them. Clothes subject to perspiration and put away without cleaning attract them because of the salt present. The starch in clothing, both old and new, furnishes food. It is while eating these added substances that cloth is damaged.

Many people consider the presence of crickets in the house a good omen. A singing cricket is supposed to bring good luck to the household. Others believe that the singing of crickets in the house portends the early approach of winter, a natural assumption where American crickets are concerned, because they enter buildings to escape the cold. The house cricket, a native of Europe but now occurring in parts of the United States, is the creature made famous by Dickens's *The Cricket on the Hearth*. In this country the late Frank E. Lutz studied the sound-making apparatus and recorded the sounds of this cricket (see Natural History, December, 1938), and the cheerful chirps of these creatures could usually be heard in his home.

The Chinese and Japanese highly prize the "songs" of their native crickets, and keep the insects in cages, some of them quite expensive, in the same way that we keep prized canaries. Male crickets are naturally pugnacious, and the Chinese have also developed a fighting race. From $50.00 to $100.00 (old currency) was about the average price paid for a good fighter. Fights between good fighters would attract thousands of dollars in bets. A cricket of Canton, known as "Ghengis Khan," is said to have won fights with as much as $90,000 (U. S.) at stake. When kept as pets, crickets will eat a variety of leafy vegetables. Lettuce is a favorite food.

Epic to be Proud of

Sirs:

Let me express appreciation of Louis R. Huber's splendid tribute to certain of our fellow Alaskans in his article, "The Incredible Conquest of Mt. McKinley." From its all-inclusive title to its final Anglo-Saxon "grit," no more words are needed. The excellent reproductions of Mr. Washburn's well-chosen photographs round out the story of an epic of which we of the North can well be proud.

Frank H. Waskey

Fortuna Ledge, Alaska

Sirs:

May I just take a moment to compliment you on the recent issues of Natural History Magazine. I notice my children seem far more interested in it than they have been in the past few years, and I know that I am finding a tremendous amount of enjoyment in simply looking through it. I also find that I sit down to read an article through rather than just to thumb through the pages as I used to do.

You certainly are doing an excellent job. Congratulations!

Irvine H. Millgate,
Director of Visual Education

Boy Scouts of America
New York, N. Y.

April

NATURAL HISTORY

1950

Golden Anniversary 1900-1950

Fifty Years o

By F. Trubee Davison

President, American Museum of Natural History

The American Museum Journal
April, 1900
The American Museum Journal
NATURAL HISTORY
NATURE EVOLUTION CONSERVATION
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October NATURAL HISTO
Roy Chapman Andrews · Jade Art · Your Own
Flight Into New Guinea · Shell Fashions · The
April NATURAL HISTOR
Lost Worlds Reborn · Fishing Bats
Fur Seals · Fiji · Pottery-making
April NATURAL HISTORY 1950
Golden Anniversary 1900-1950
FIFTY CENTS

Natural History Magazine had its origin in April of 1900 with the publication of a small, 16-page leaflet, *The American Museum Journal.*

In those early days, with something less than 1000 members on its rolls, the Museum felt the need for a periodical that would provide information on Museum activities and exhibits to scientists and members.

What is known throughout the

Progress

world today as Natural History Magazine was at that time envisioned as an aid to a small group of scientists and laymen. The initial publication, under the careful editorship of Dr. William K. Gregory, who is now known internationally as one of the world's foremost authorities on comparative anatomy, was successful in acquainting this audience with the activities of a relatively young institution.

The first half of our twentieth century might well be termed the era of scientific awakening. Probably no other period in history has been marked by such outstanding scientific achievements. The very term "science" has only come into broad usage during this half century when a bewildered public sought to keep pace with the almost unbelievable accomplishments of the scientists.

Hundreds of magazines have come into being during this time, each competing for the public eye. Honest reporting has had to compete with propaganda journalism. The survival of serious, informative, and truly inspiring periodicals has been threatened by sensational ones. The progress we have enjoyed has been made possible by the encouragement and support of those who believe in these objectives.

Publishing activity has been by no means less feverish in the scientific field than in any other. Amid the spectacular interest that is daily captured by the technological sciences, progress with a magazine devoted to the enduring truths of nature has not been easy. There is a far greater volume of material published each month on the physical and mechanical sciences, but we are gratified to learn that few magazines are saved from the wastebasket and cherished so long by their subscribers as Natural History.

The story of Natural History is, I believe, unique in publishing annals. The problems confronting every commercial publication have sometimes seemed minor when compared with those Natural History has endured for half a century. In commercial publishing, every resource at the command of the publisher is directed toward the magazine, its production, its editorial make-up, and its promotion and circulation. Natural History is not published by a commercial concern. It is published by a great American scientific and educational institution as but one phase of an extensive and world-wide program which exerts a tremendous educational influence on millions of people every year.

In view of the scope of the Museum's activities, plus the limitations of staff and budget expenditures in all departments, it can readily be appreciated that the Museum has been unable to give Natural History Magazine the financial support it certainly deserves. The severe limitations under which Natural History has had to work for the past 50 years would have long since relegated to oblivion most commercial publications. Indeed, many periodicals favored with abundant operating capital have gone under during this period.

During the early years of its existence, the editorial content of Natural History was directed solely to those of a scholarly, scientific mind. A circulation saturation point was soon reached in this limited audience. Consequently, Natural History broadened its coverage so that its editorial content would be found understandable, entertaining, and educational to a much larger group. An almost insurmountable problem, however, was to make the American public aware that such a magazine was available. This was a job of promotion and selling.

As every person engaged in business knows, to promote and sell a commodity successfully entails considerable financial expenditure, and this the Museum was unable to underwrite. Those in charge undertook to accomplish a job that was readily labeled "impossible" by professional circulation experts. Since we could not raise ourselves in any other way, we had to do it by our own bootstraps.

The circulation growth of Natural History has not been meteoric, but its success does astound the commercial world when it is understood how little was spent to achieve our present circulation of more than 40,000 paid readers. It is significant too that the Magazine has not resorted to exotic interpretation of the natural sciences in order to garner widespread attention. The editorial advisers have felt that anything verging on the overdramatic would render Natural History ineffective in the dissemination of facts in the natural sciences.

During its existence, Natural History has published more than 15,000,000 words and over 27,000 illustrations. It has given its readers the personal accounts of the most celebrated explorers of our time, and it has set no limits on its geographical or historical range. It has stirred many an American home both with the wonders of far-flung places and with the sometimes more startling mysteries and marvels of nature close to home. All this has been accomplished through the unflagging industry of a small editorial force and of an office of circulation and promotion that has been seriously handicapped by shortage in personnel and facilities.

The officers of the Magazine feel that there are hundreds of thousands of people in this country and abroad who would welcome learning about Natural History and who would be willing to subscribe to it. Here is a family magazine that inspires wholesome thinking and embodies a philosophy of simple, intelligent living. We enter our second half-century with gratitude for the encouragement and support that all our readers have given us and with fervent hope for the future of a periodical that exemplifies and moves forward in a sphere of human thought and experience that is constantly increasing in importance.

Keystone

Gendreau

The Gifts of Nature

By HERBERT HOOVER

I was a boy in the days before our civilization became so perfectly covered with cement and bricks. As a boy in the villages of Iowa and Oregon, aside from chores, it was my business to discover the world all over again. There were the wonders of the woods and the streams with their animals, their birds, and their fishes. There was the miracle of the growing crops, the excitement of the harvest and of the homemade Christmas. There was the comfort of the family fireside in a civilization where every season produced the bread, the meat, the vegetables, and the fruit which gave social security over the winter.

Afterward my engineering profession took me to many foreign lands, where I dealt with the people of many nations and nationalities. My boyhood interest in the birds and the beasts and the fishes continued.

And it has been my privilege to work with great spiritual leaders and great statesmen. I have worked in governments of free men and in governments without freedom. I have seen happiness; I have witnessed destruction, great troubles, and sadness: the battlefields of two frightful wars, the suffering of famine and pestilence. I have seen people devoted to their governments, and I have seen people rebel against their tyrannies. I have seen them cling to recreation at the woods, the streams, and the sea as an escape.

Those countries where the people were devoted to their government were those in which the individual was free to choose for himself and to develop his own talents and enterprises. But the opportunity to develop was limited by the natural resources, and these came from Nature itself—not from governments. This development of nature's offerings was not alone their bounty but was the product of freedom and the ingenuity of races. We descendants of Western Europe are mechanically-minded and take to making and running machines, while the peoples of Asia and Africa, with different backgrounds, imitate and fumble with them.

But amid all these machines, bricks, and cement, there is the primeval joy of all races of getting back to nature—for recreation and to wash one's soul of the complexities of our modern life.

One of the products of the mechanical age is to give us more spare time. What we do with this leisure has to do with the spiritual life of both the individual and the nation. As a nation, Americans have done much to bring recreation nearer to nature itself. Between 1928 and 1932, our National Parks and Monuments increased 40 per cent—and we have improved the hunting and fishing. Hunters and fishermen are not those who fill our jails.

Many of these opportunities of the out-of-doors were destroyed by the march of cultivation of the land and the use of our resources for personal comforts. But we still have great opportunities, for no one can destroy the magnificent monuments of nature. And these bountiful gifts with which our land is endowed are part of our sacred national trust.

From them, the contemplation of the flow of the stream, the cathedrals of the redwoods, the majesty of the mountains—all remind us of our humble role in the order of things. Many of us have to work at the bench and in the shop. We cannot go to these refreshments of the mind as much as we would like. But such institutions as the American Museum of Natural History make available to all of us and our children the wonders of nature—and remind us of the Gifts of Nature from which we derive so much of our strength.

NATURAL HISTORY

The Magazine of the American Museum of Natural History

F. TRUBEE DAVISON, PRESIDENT
WAYNE M. FAUNCE, Vice-Director
In charge of Publications
ALBERT E. PARR, Director

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APRIL, 1950

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From a Kodachrome by Josef Muench

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THE COVER THIS MONTH

Mitten Butte is a familiar landmark to many travelers who have chosen to put the well-traveled routes behind them and struck north from Kayenta, Arizona, into Monument Valley. Throughout our Southwest and even the world, the spires and mesas of Monument Valley stand as a classic example of the startling topography that can be carved by natural forces in an arid or semiarid climate. Warm hues of brown and yellow tint the buttes and shafts of rock that dot this elevated landscape and impart an unearthly beauty. Most visitors, however, particularly if they visit the region in a hot, dry spell, do not think of this portion of our land as being a riot of floral coloring. The cliff rose, technically known as *Cowania stansburiana* whose golden blossoms enliven the foreground of this photograph, is a leafy evergreen shrub that grows frequently on cliffs and belongs to the rose family. It grows to a height of from three to twelve feet and occasionally twice as much. It is often called quinine bush because its twigs and leaves are quite bitter, but this does not prevent cattle, deer, and sheep from feeding upon it. The Hopis prepare from the plant an emetic and a wash for wounds. —ED.

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The American Museum is open to the public every day in the year without charge

The Next Half Centur

Eight scientists at the American Museum give a qui

Rapid Progress or Rapid Defeat

Through leisurely processes requiring millions and millions of years, animals became specialized for life on earth, in air, and in water. Man, a comparative newcomer, was earth-bound. Barehanded, he kept to his limited habitat until technical accomplishments provided a short cut across the eons. Today he has overrun the earth, he lives in the air, and only the ocean depths oppose him.

The greatest speed-up in this human expansion came in the past fifty years. The next fifty, with the Atomic Age luring him on, may well place man at the utmost capacity for life achieved by any creature and carry him far beyond anything common to our present experience. This, if his use of the shining tool is wise; the Atomic Age can well spell his doom.

Harold E. Anthony
Chairman, Department of Mammals

New Comprehension, Power, Guidance

Constructive study of evolution will oppose the powers of physical destruction and spiritual bondage. The synthesis of evolutionary science will increasingly involve all life sciences and extend farther into the psychological and social sciences. The goal is increased comprehension, power, and guidance: *comprehension* of how life has arisen and developed, of our place in the living world and the universe; *power*, through knowledge of the principles of organic change, to influence desirable development of man and other organisms; *guidance*, derived from true understanding of life, toward the achievement of sound ethical and social values as the basis for peaceful brotherhood of mankind.

G. G. Simpson
Chairman, Department of Geology and Paleontology

in Science

impse of tomorrow

Fewer Atomic Worries—Graver Population Problems

This is not a prophecy. It is an article of faith combined with a piece of guesswork. First, I believe, in common with many others, that mankind has a future, because man can and will rise to the moral demands implicit in the possession of the self-destructive powers he now has learned to manipulate.

Admitting this probability, I judge from existing population dynamics and from advances in technology that the world's population will increase by at least fifty per cent in the next fifty years. The task we face is the tremendous one of understanding the economic, social, and political stresses that will result and of discovering a method of dealing with them.

Harry L. Shapiro
Chairman, Department of Anthropology

Empty Mines—Heavy Statute Books

The increasing drain on our mineral resources makes it certain that the accessible deposits will be depleted by the end of the century. Two developments are to be expected: a vigorous investigation of more remote sources, and expensive scientific prospecting for low-grade and concealed ore bodies. Scarcity will increase the cost of metals and render practical their recovery from poor sources now considered uneconomic, possibly including sea water. With the exhaustion of "inexhaustible" resources and a new appreciation of the importance of metals, we shall see governmental limitations placed on the individual's right to exploit or use them for private gain.

F. H. Pough
Curator, Physical Geology and Mineralogy

INSANE ASYLUM

Dull Diet, Desperation, and a Population Plan

I believe that by A.D. 2000 mankind will have worked out the technical problems of food production far enough to permit the earth to support many more than the three billion then on it. Already we can produce enough yeast from an acre of sugar cane to supply the annual protein requirements of over 100 persons. However, I am convinced that wherever a country's entire population is being forced to eat little except such unpalatable foodstuffs as yeast "steak," algal "butter," and wood "sugar" in order to stay alive, we shall see vigorous steps taken to reduce the population to a level where the available land can support it on more appetizing foods.

Richard H. Pough
Curator, Conservation and Use of National Resources

Change and Growth Through Understanding

Our task is to bring into moving equilibrium our knowledge of the physical world and our special knowledge of human beings. This involves learning how to bring to the study of human beings our full humanity, how to include the observer within the observational situation. To do this we need to orchestrate studies of human behavior from many different civilizations, so their historically developed insights may each contribute some of the hypotheses essential to a scientific understanding of mankind. Such a method generously employed should lay the groundwork for a world civilization capable of change and growth in an increasingly understood universe.

Margaret Mead
Associate Curator of Ethnology

BROTHERHOOD THROUGH SCIENCE, ART, AND MUSIC

I predict that the growing need for international understanding will lead to the development in New York City of an entirely new type of institution for the presentation of cultural and scientific subjects. Enjoying the broadest foundations, this sister to the United Nations will embrace the arts, history, health, and science and will include the portrayal of opera, symphony, folk dances, and choral programming. Through it, audiences will be placed in the environment of each country around the world and be able to hear, see, and feel how other people live. I predict that such an institution will have a large share in promoting better understanding among the peoples of the world.

GORDON ATWATER
Chairman, Astronomy and the Hayden Planetarium

A NEW PARTNERSHIP BETWEEN SCIENCE AND EDUCATION

The half century from 1850 to 1900 was characterized by an attempt to gain scientific understanding of the physiology and origin of man. Since 1900 there has been a scientific approach to the psychological processes of man. The next half century must see the scientist concerned with the extension of his science to include the improvement of man as a social being. Therefore, for the first time in history, the scientist and the educator must progress along the same road, side by side, in mutual recognition of the fact that science not only extends the world but is essential to its welfare.

CHARLES RUSSELL
Chairman, Department of Education

Drawings by Paula Hutchison

It's for You to Choose

We think of 50 years as a long time. On Earth's great timepiece, it is a second. But there is a sundial that says: "It's later than you think."

Once, long before man, it was *size* that counted. A little animal only a foot long, which has been popularly called Leaping Lena, founded a dynasty of giant creatures that could reach leaves three stories above the ground.

If we could have watched the growth of the dinosaurs through 140 million years, we might have believed that size and strength alone were most desirable for success. But Nature had something else in store—something that was to wipe the giants from the earth, almost as if they had never lived.

It became common for a small animal to win over a large one. In a limited sense, the meek inherited the earth. Actually, a better nervous system was evolving. Evolution was laying the foundations for the creature that talks, laughs, plans, and calls himself master of the world—the creature that invents, chooses, and learns from books—the creature whose mysterious desires can bring him close to God and whose pride can cast him lower than the beast.

This creature shivered his way through half a million years before he discovered how to make fire. It took him almost as long again to make a good machine to put it out.

Evolution teaches that three things are necessary to produce change—Variation, Selection, Transmission. If all of Leaping Lena's children had been alike, there could have been no change. But anyone who has raised dogs knows that there are variations in every litter. In the wild, some young are better able to survive the hazards of life—are stronger, swifter, more gifted in the arts of concealment. So a process of natural selection takes place. The ones better fitted to meet life's conditions are more apt to survive to maturity. And some that reach maturity are more likely to secure a mate, produce their kind, and transmit their effective traits to the next generation.

There is a comparison between this kind of evolution —organic evolution—and cultural evolution.

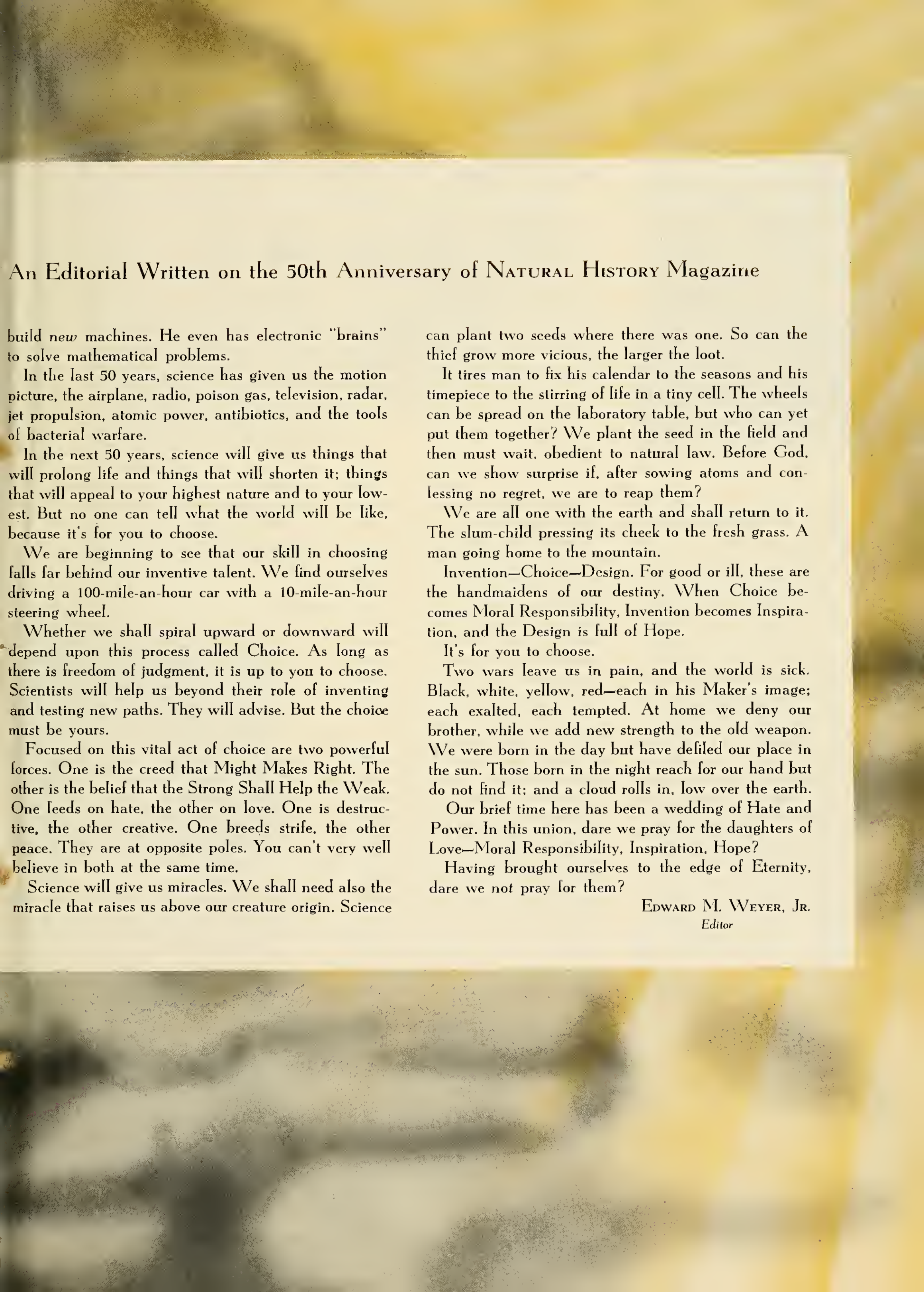
The difference is that cultural evolution refers to all the tools that man uses and all his laws and social institutions. These are not passed on by heredity but chiefly through books and spoken tradition.

In cultural evolution, *invention* plays the part of *variation. Choice* takes the place of *natural selection*. And a lot of things that might be bunched together under "*education*" take the place of *transmission* and keep alive the tools and customs we judge desirable. They form the design for tomorrow. The design is the heritage we leave our children.

So we have Invention, Choice, Design.

Speech was the first great achievement that put man on the road to cultural evolution. It permitted the transmission of powers from parent to child without heredity. Written language greatly quickened the process, because it took the burden off memory.

Man now has a multitude of machines to help him



An Editorial Written on the 50th Anniversary of Natural History Magazine

build *new* machines. He even has electronic "brains" to solve mathematical problems.

In the last 50 years, science has given us the motion picture, the airplane, radio, poison gas, television, radar, jet propulsion, atomic power, antibiotics, and the tools of bacterial warfare.

In the next 50 years, science will give us things that will prolong life and things that will shorten it; things that will appeal to your highest nature and to your lowest. But no one can tell what the world will be like, because it's for you to choose.

We are beginning to see that our skill in choosing falls far behind our inventive talent. We find ourselves driving a 100-mile-an-hour car with a 10-mile-an-hour steering wheel.

Whether we shall spiral upward or downward will depend upon this process called Choice. As long as there is freedom of judgment, it is up to you to choose. Scientists will help us beyond their role of inventing and testing new paths. They will advise. But the choice must be yours.

Focused on this vital act of choice are two powerful forces. One is the creed that Might Makes Right. The other is the belief that the Strong Shall Help the Weak. One feeds on hate, the other on love. One is destructive, the other creative. One breeds strife, the other peace. They are at opposite poles. You can't very well believe in both at the same time.

Science will give us miracles. We shall need also the miracle that raises us above our creature origin. Science can plant two seeds where there was one. So can the thief grow more vicious, the larger the loot.

It tires man to fix his calendar to the seasons and his timepiece to the stirring of life in a tiny cell. The wheels can be spread on the laboratory table, but who can yet put them together? We plant the seed in the field and then must wait, obedient to natural law. Before God, can we show surprise if, after sowing atoms and confessing no regret, we are to reap them?

We are all one with the earth and shall return to it. The slum-child pressing its cheek to the fresh grass. A man going home to the mountain.

Invention—Choice—Design. For good or ill, these are the handmaidens of our destiny. When Choice becomes Moral Responsibility, Invention becomes Inspiration, and the Design is full of Hope.

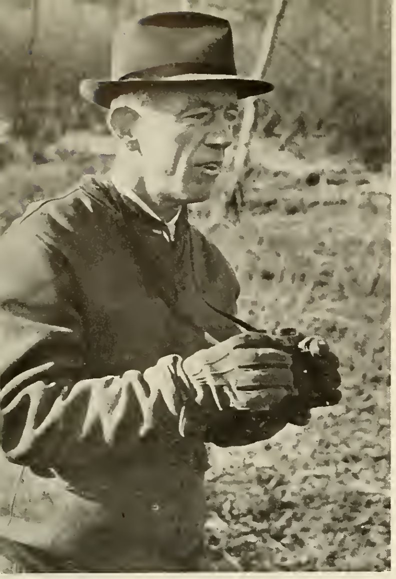
It's for you to choose.

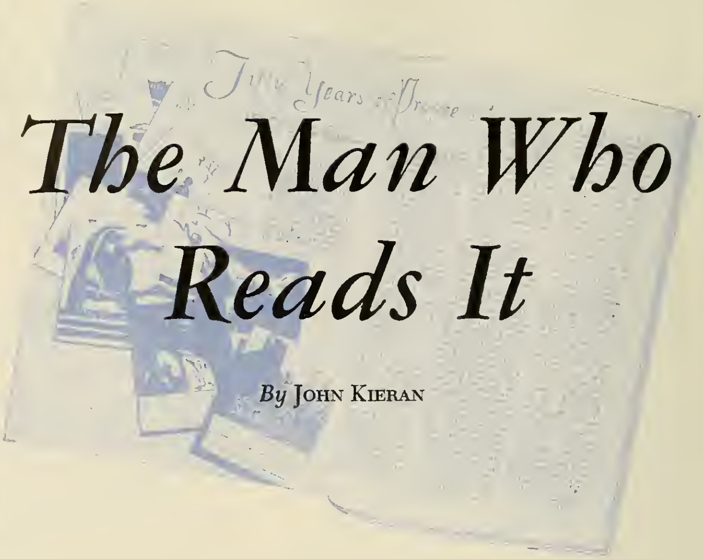
Two wars leave us in pain, and the world is sick. Black, white, yellow, red—each in his Maker's image; each exalted, each tempted. At home we deny our brother, while we add new strength to the old weapon. We were born in the day but have defiled our place in the sun. Those born in the night reach for our hand but do not find it; and a cloud rolls in, low over the earth.

Our brief time here has been a wedding of Hate and Power. In this union, dare we pray for the daughters of Love—Moral Responsibility, Inspiration, Hope?

Having brought ourselves to the edge of Eternity, dare we not pray for them?

Edward M. Weyer, Jr.
Editor





The Man Who Reads It

By John Kieran

FIFTY years ago in New York City there occurred two events, one of which was noteworthy. That was the founding of Natural History Magazine at the American Museum of Natural History. The other, of somewhat lesser importance to the world at large, was my first intrusion into the halls of the same museum. Possibly the editors were even then editing copy or correcting proofs of the first issue of this magazine as I wondered along under escort of my father. But though I wrote a fair round hand for a boy of seven, I was not invited to contribute anything to the periodical that was about to be launched so successfully. I have been a regular visitor to the museum ever since that comparatively ancient day, and a constant reader of this magazine for many years now. I think the museum and the magazine have taken notable steps forward in the past fifty years, and it's a good thing, too, because the need for such a museum and such a magazine has steadily increased over this period.

Consider the drift in our population. There was a time when most of the inhabitants of the United States lived on farms. They knew Nature because they had to wrestle with it to make a living. They knew crops. They knew trees. They knew birds and animals. Weather was important to them. They lifted their heads to the stars on clear nights. Moonlight had social significance in the farming districts. Who pauses to look at the moon over Manhattan? Nearly 80,000,000 of our population are now classified as "urban dwellers" or, to be frank about it, city folk. This is the era of mechanical marvels. We have the assembly line in the factory and the push-button technique in the office. We are surrounded with so many mechanical aids and manufactured gadgets that we often act like mechanical men. We forget we are human beings. In our admiration—verging on adoration—of the electrified, streamlined, jet-propelled modern world of skyscrapers, television, stratospheric flight, and atomic energy in which we live, we are losing sight of the far greater immortal miracles of Nature that are all around us—from the tiniest drop of water that can be put under a microscope to the great stars in their distant courses, some of which dwarf not only the Earth by comparison but "our whole dinged solar system," as Bert Leston Taylor put it in his famous lines about Canopus.

Matthew Arnold wrote of Sophocles that he "saw life steadily and saw it whole." All too many of us can't take that broad view these days. We are trapped within walls. We have too many miles to go before we can get off paved streets and plant our feet on solid ground. Life in a big city is becoming a rat

Dear Editor:

It was with surprise and pleasure that I learned from your letter that my name had been picked at random from the thousands of Museum members and Natural History Magazine subscribers to tell why I am a reader of your splendid publication.

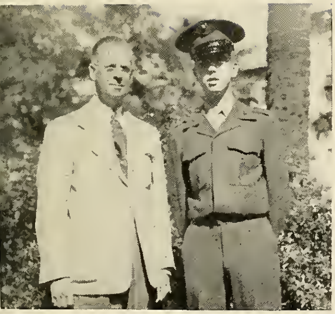
When, by chance, several years ago I heard of Natural History, I immediately subscribed because my son has always been a typical outdoor boy, wandering in the woods and being thrilled with his observations of wild animals and birds. I could write pages of his bringing home all kinds of animals found locally, and once he even raised a young hawk.

Natural History proved to be his most treasured magazine, for he has enjoyed it to the utmost and preserved every copy.

I always had only a normal, passive interest in nature, but I find that now, being an avid reader of Natural History, I am more conscious of the world of nature about me, and I am amazed at how much knowledge I have acquired and retained through the years about the peoples of this planet and the fascinating story of Mother Earth.

My son is now with the U. S. Marines stationed in Guam, and when his mother and sister and I have finished with each issue of Natural History we send it to him, for this is one of his most insistent requests. He has written us many interesting stories about wildlife there in the jungle. It is your magarace. The modern age is so marvelous that for most of us it's like the Looking Glass land into which Alice ventured, where the pace was so fast that the Red Queen warned Alice, "It takes all the running you can do to keep in the same place." We rush so much that we lose track of time. We concentrate so much that we narrow our vision. There is a wonderful world around us to explore and enjoy. That's the reason for the existence of the American Museum of Natural History. That's the reason for the publication of NATURAL HISTORY Magazine and the justified jubilation on the occasion of its fiftieth birthday.

In the museum and in the pages of this magazine we can and do travel far by land, sea, and air. We visit Africa, Asia, Australia. We take trips to the arctic and antarctic, with all the thrills of the explorers and none of their hardships. We look into the interior of the Earth. We find rare metals. We learn the cause of earthquakes. We go down to the depths of the ocean and see astonishing forms of marine life. We visit the tropics and see strange flowers and birds of almost incredible plumage. We look through a telescope and see a pin point of light that may be a star ten times the size of our Sun. We learn why we have eclipses of the Sun and Moon. We discover that the most adventurous of men lead humdrum lives in comparison with the fantastic careers of many insects. We are finally convinced that the largest living creature ever seen on Earth was not some scaled and tailed prehistoric monster that we know only through ancient bones or fossilized footprints on the sands of Time but a warm-blooded, seagoing animal that still lives and breathes in this modern age—the great Blue Whale.



zine that has sharpened his eye for these things.

NATURAL HISTORY has another important value to me personally, for, you see, I am employed by the Grand Rapids Varnish Corporation as Finish Consultant and Stylist in Color, and I find your beautiful color covers and your unusually splendid photography a help in my profession.

I congratulate you upon the achievement of the fiftieth anniversary of your great magazine and do hope that you will succeed in placing it in many more American homes where it will be valued as a family educational reference for many years, as it is in my home.

Yours sincerely,
D. J. BUCKLE
Grand Rapids, Mich.

How much all this means to others I have no way of knowing with accuracy, but it has been a great part of my own life. As a boy, I was always fond of hunting and fishing and camping, but it wasn't until I was out of college that I became deeply enmeshed in the delights of amateur ornithology. From the attic window of our house in the Bronx I could look out over the waters of the Jerome Park Reservoir. One winter day I saw that there were many scattered ducks on the reservoir. I borrowed a pair of field glasses, sneaked along the iron fence that circled the reservoir, and looked over the ducks to identify them. Some I was unable to identify until I went back to the house and peered into my Chapman's *Handbook of Birds of Eastern North America.* I saw fourteen species of wildfowl on the reservoir, and the group included one white-winged scoter, some canvasbacks, a few redheads, and a hooded merganser.

At the Bronx Zoo that winter I met a man who had a way of getting bird notes into a column in the N. Y. *Evening Mail,* a newspaper now long out of print. I induced him to go with me to the reservoir to see "my ducks," and in due time their presence on a reservoir in New York City was made known in a paragraph on the editorial page of the *Evening Mail.* That brought some visitors from the American Museum of Natural History to look over the duck situation in the Bronx. I encountered two of the museum men on my rounds and told them I was keeping a daily watch on the coming and going of the various species. They nodded approvingly. To this very day I feel a little proud of those nods of approval, because the two men from the museum were Charles Rogers and Ludlow Griscom!

Some months later, when Dr. Rogers saw how deeply enthusiastic I was about birds, he asked me to go with him to the meetings of the Linnaean Society of New York at the American Museum of Natural History, and he very kindly put me up for membership. Nobody arose to oppose the nomination, and I was duly elected. I have been a member of the Linnaean Society ever since.

I often felt like one of the conspirators in *Julius Caesar* as I hurried along 77th Street in the darkness, turned at the driveway leading to the brooding old building, slipped under the dark archway, and whispered the password "Linnaean" to the challenge of the uniformed attendant at the door. It was a thrill to attend those little gatherings of long ago, but it is a much greater thrill now to walk through the spacious halls of the new wings of the museum and see the marvelous habitat groups of birds and animals, the antelope groups that might delude a visitor into thinking that he was on the African veldt, and the Pacific bird groups that lure the bird lover "on from island unto island at the gateways of the day."

As the American Museum of Natural History has expanded nobly and improved immeasurably, NATURAL HISTORY Magazine has made remarkable progress in the presentation of important and fascinating subject matter. What is offered in NATURAL HISTORY is the truth that is stranger than fiction. There are stories of scientific journeys to the ends of the earth. They are written by men who know their subjects

Continued on page 191

CAMOU
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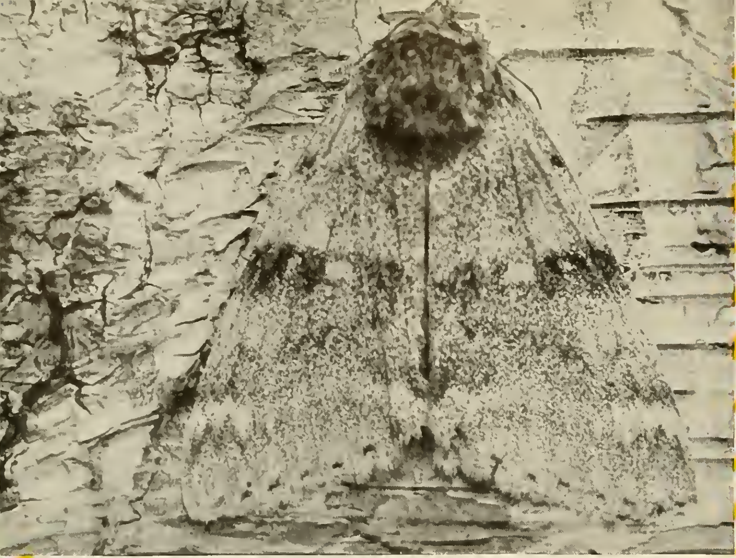


▲ THE OUTLINE OF THE WINGS in this moth (*Catocala relicta* Walker) is lost against the bark of the tree

The art of concealment makes many a weak creature strong in the struggle against its natural enemies

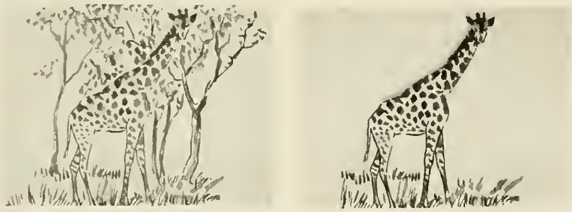
By LORUS J. *and* MARGERY J. MILNE
University of New Hampshire

Photographs by the authors unless otherwise credited

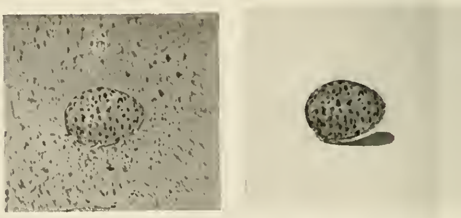
FROM the beginning of life on earth, all the varied creatures of the animal kingdom have had one objective in common—the need of finding a square meal. And since every creature is liable at one time or another to be looked upon as a possible source of food by some other animal, survival has depended upon various arts of concealment. We are all aware of the furtive tactics of a cat stalking a mouse and of the habit of the mouse to seek dark places and to enter openings too small for a larger animal. But nature has also endowed many animals with startling physical attributes that help them to escape notice—in short, with natural camouflage.

To be successful, camouflage requires that an animal blend so perfectly with its background or surroundings as to be indistinguishable from them. It is a means of concealment through absence of contrast. This lack of contrast may be in tone, in texture, or in color. Thus a killdeer's eggs on a bare sea beach, a rabbit crouching among roadside weeds, an underwing moth on a gray tree trunk, all challenge human vision. Usually each is passed unheeded—an unseen example of the protective resemblance so widespread in the animal kingdom. Each taxes the most observant eye and also the brain that interprets the eye's seeing. Each trick of camouflage has a definite survival value for the creature concerned.

Colors are so much a part of our everyday life that it is difficult to think of the world without them.



Against a confusing background of foliage, the spots of the giraffe look like patches of shadow and serve to hide the profile of an animal that is famous for its grotesque shape



A speckled egg is hard to see on a bare beach unless there is strong shadow: an example of protective resemblance

FLAGE

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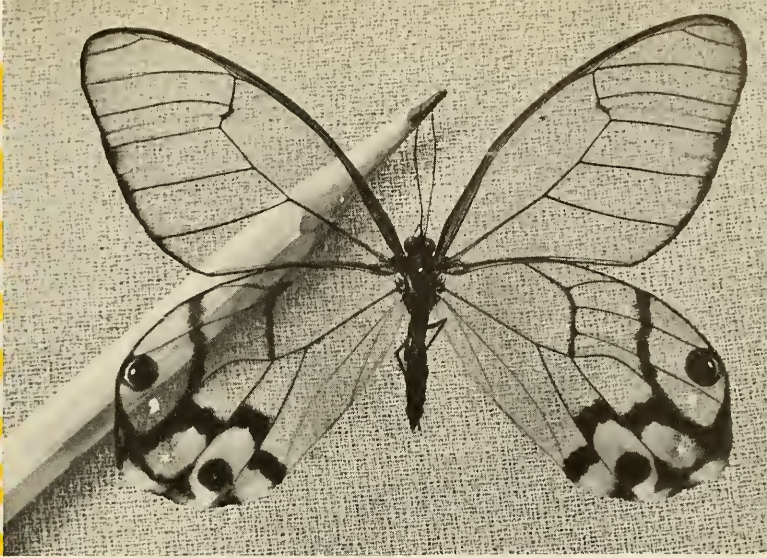
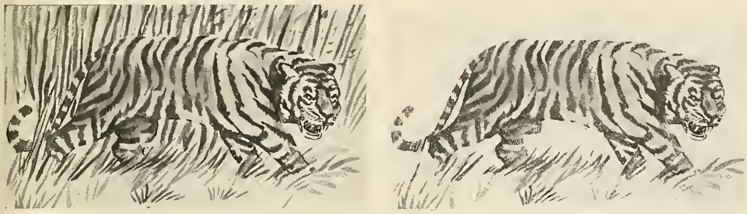

Ward's Natural History Est. photo

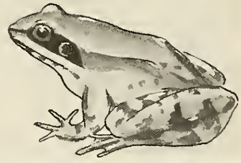
▲ The Glass-wing Butterfly (*Haetera piera* L.) from the American tropics is so transparent that it is hard to see in flight

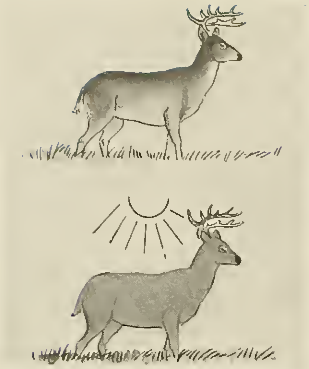
But as far as can be learned, we and the other primates (monkeys, apes, and their kin) are the only mammals that can distinguish the various regions of the spectrum except through differences in brightness. Birds, fishes, and insects may have good color vision, though different from ours. But among our familiar four-footed friends—the horse and cow, dog and cat, rabbit and guinea pig—we find no recognition of color. For them scenery, enemies, and mates exist only in shades of gray. How then do their eyes evaluate what we call camouflage? What is protective coloration to an animal that is truly color-blind?

For us, the landscape and its inhabitants consist of a kaleidoscope of multicolored patches—some light, some dark, most in-between. We depend upon our mental analysis of this patchwork when inspecting objects beyond our reach. Outlines, we conclude, must mark off separate parts. Sudden changes in color or brightness are portions of the outline. Gradual transitions suggest continued planes, while roundness and shadow-casting go hand in hand. We base each judgment on combined appreciation of difference in color and variations in brightness. Yet where this color sense is lacking, the same scene need not mean monotony. Only photographers dream up the extreme examples and point out that a white cat sleeping on an ermine coat spread under a noonday snowstorm (a "high key" picture) may be just as devoid of details as a black cat eating licorice in an unlit coal cellar at midnight (a "low key" picture). Both situations are extremes rarely met with. Neither involves color. But a green katydid imperceptibly quivering its green wings to scrape out its familiar calls on a dark night is no more contrasty on a green leaf when illuminated by a floodlight. To us it has color, but so successfully does it match the surrounding foliage that its vociferous presence may escape our diligent search.

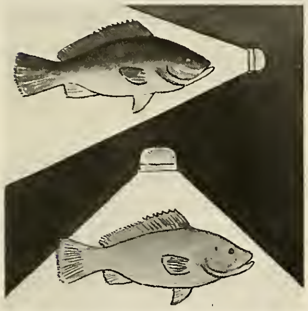
In spite of our ability to distinguish colors and the excellence with which our eyes identify delicate differences in tone or detailed pattern, our initial reactions to


"Disruptive coloration" distracts the eye from the natural outlines of the animal and eliminates the silhouette. Thus the body blends into the background or appears to be broken into disconnected parts

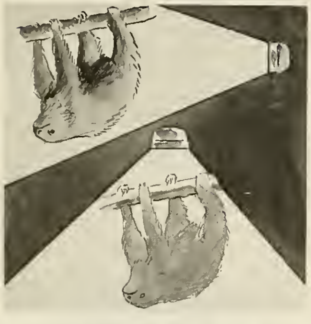

The frog's neat circle of an eye would attract attention were it not for a disruptive stripe of coloring that passes through the eye and continues along the head



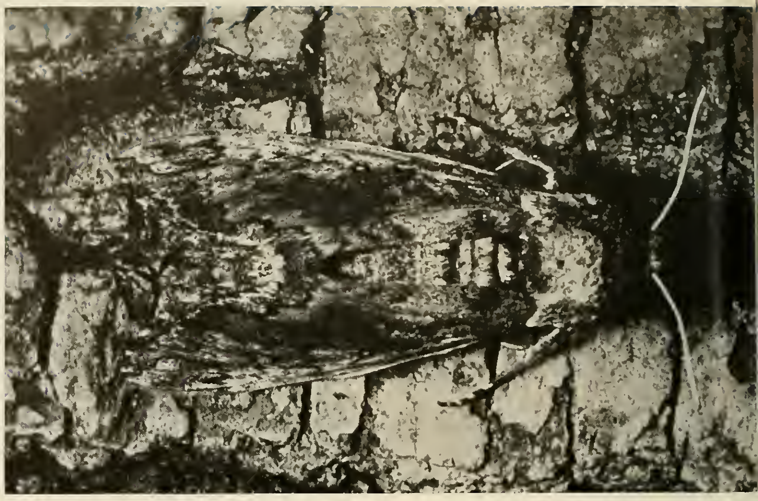
Sunlight brightens an animal's back and casts shadows on its underside. Hence, most four footed animals are lighter underneath than on top



A fish lighted from directly in front would also show this conspicuous distribution—darker above and lighter below. But with light coming from the normal direction, the body blends into the background



The sloth, because it lives its life upside down, is fortunate to have the usual pattern reversed



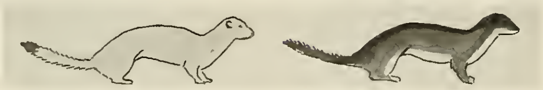
▲ ALTHOUGH CLINGING to the bark of a fallen pine tree in full sunlight, this large hawk moth went undetected until, in nervous response to the photographer, the insect raised its gray antennae. Previously these feelers had been hidden under the sides of the body

most objects are in terms of the most pronounced feature. This is frequently the over-all silhouette. At least one school of fashion design has insisted on student recognition of this basic fact in vision. Everyone has seen how easy it is to confuse new acquaintances when their silhouettes shift from street attire to bathing suit or evening gown. A witness to a robbery may know only that he saw a tall, thin man or a short, fat one. Of course, if the robber wore a bright yellow raincoat, that might be the most conspicuous feature. But even among our close friends, it is often the combination of silhouette and movement that allows recognition. "Yonder comes Antonio. I ken him by his gait."

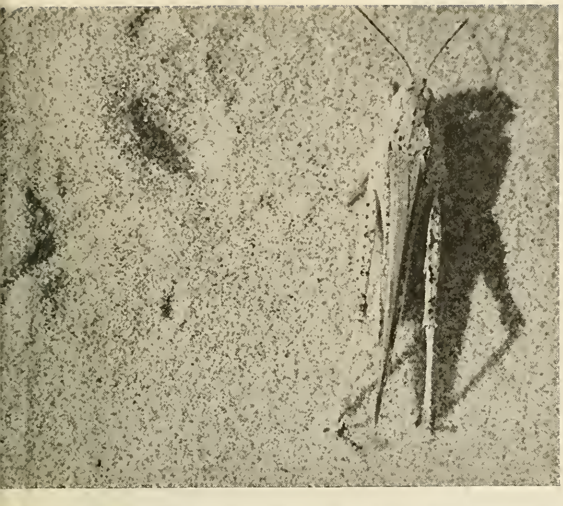
Birds against the sky often appear only in silhouette, but the naturalist knows them by their flight—the undulations of goldfinch and flicker, the ponderous rhythmic flapping of a string of pelicans, the V's of migrant geese. Insects too small, too indistinctly marked to be seen clearly at a few yards' distance, become hover flies, dung beetles, gnats, bees, caddis flies, or moths according to clues given in their gyrations through the air. This is high contrast—the opposite of camouflage. A silhouette must be destroyed for an animal to disappear. The various means employed all gain this end.

Disruptive Coloration

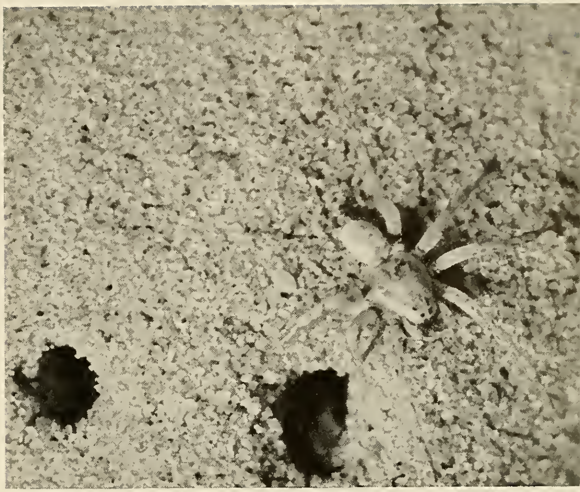
One effective means of concealment is based on distraction. On its body the animal may wear an irregular pattern of spots, stripes, or other markings that catch the eye and hold it, drawing attention to meaningless details and away from the creature's outline. This eliminates the silhouette, by means of which the whole might be identified. We call this trick "disruptive coloration." It serves to separate a single body into a series of seemingly disconnected, unimportant parts. A fawn in the spotty shade of an open woodland becomes a series of sunlit patches on a brown lump devoid of distinctive contour.



Many animals living in regions that are snow-covered part of the year undergo a change in their fur, like the weasel shown here



▲ THIS GRASSHOPPER'S SHADOW gives it away, and the strong side lighting also shows up its footprints in the sand. In midday illumination, however, the insect hides its own shadow and vanishes from view by merely staying still



▲ PAUSING near the burrows of the common beach flea, this pale, creamy-white spider could be overlooked more easily than found again. At night it can be located with less difficulty—but only because its eyes reflect the beam of a flashlight

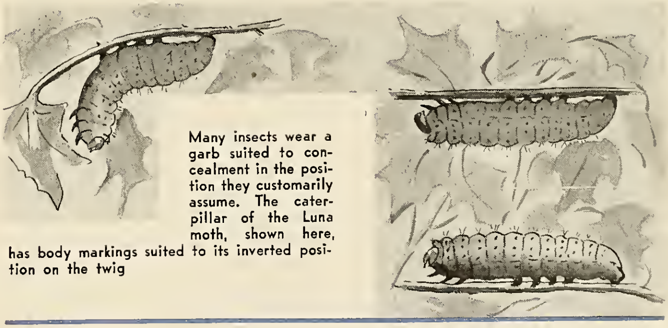
A badger crouching in a field turns toward you a face sharply marked in alternating vertical bands of cream and blackish-brown, and you tend to overlook the outline of the head itself. The coarse camouflage painted on military installations achieves its purpose in the same way. The marks may simulate a number of different objects—none of them clearly recognizable—and distract the eye from the true boundaries. The scaly, mottled color pattern of a water snake, the contrasty feathers of a killdeer, the wing markings of numerous moths and butterflies have this uncanny ability to confuse the eye.

Related to disruptive coloration is another type of pattern. The markings on an animal's back may be continued irregularly and across actual spaces onto thigh and shank so that the appendages merge as one mass when the creature is crouched in repose. Insect wings commonly carry the coloration from one pair to the overlapping set, and among moths the two front wings may meet to form a common contour. These methods introduce continuous disruptive bands and mottlings that bear no reference to the outlines of the separate appendages and serve to conceal the body parts. Perhaps the most spectacular of them are the devices that conceal eyespots. The neat circle draws attention, and a wood frog's eye would have an obvious iris were it not for a pigment stripe through it that continues the dark disruptive band along the amphibian's head. In many insects and fishes the very outline of the body itself is irregular—almost ragged—so that no clear shape stands out to distinguish the creature from its background.

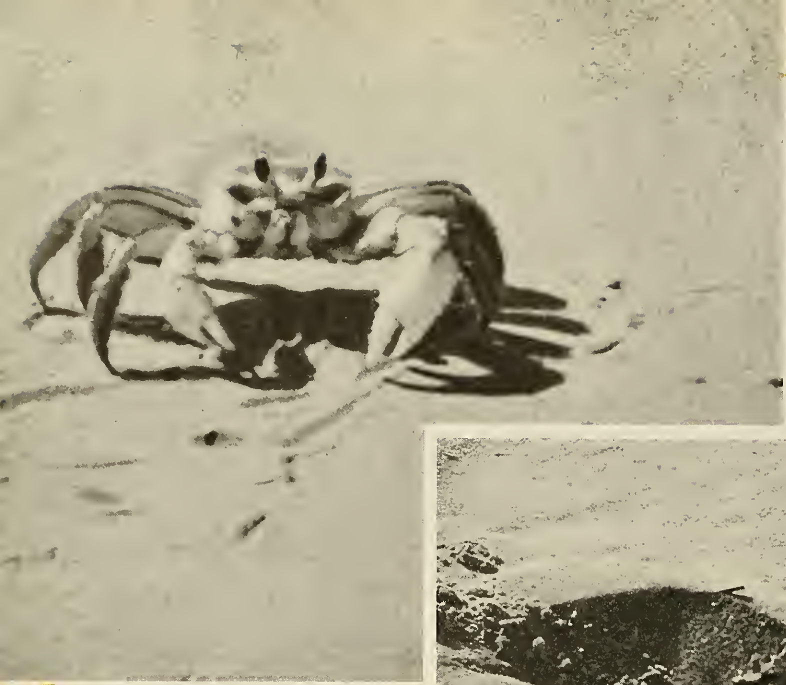
Transparency

A few animals blend with their surroundings wherever they go because their bodies are so transparent that the eye sees through them as through so much cellophane. The Glass-winged Butterfly of the South American tropics is a classical example—one of the few on land. Animals that frequent upper levels of the sea are often diaphanous, such as jellyfishes. Some, like the early stages of the eel and a few prawns, achieve this clear quality in all but a few vital organs, yet they have firm bodies, good sense organs, and active habits. Whether at rest or in motion, these creatures are difficult to discover.

But transparency is difficult to achieve. It is far simpler to match a customary background composed of blended shades of gray or green or buff. Of course, the animal must then keep to the appropriate back-

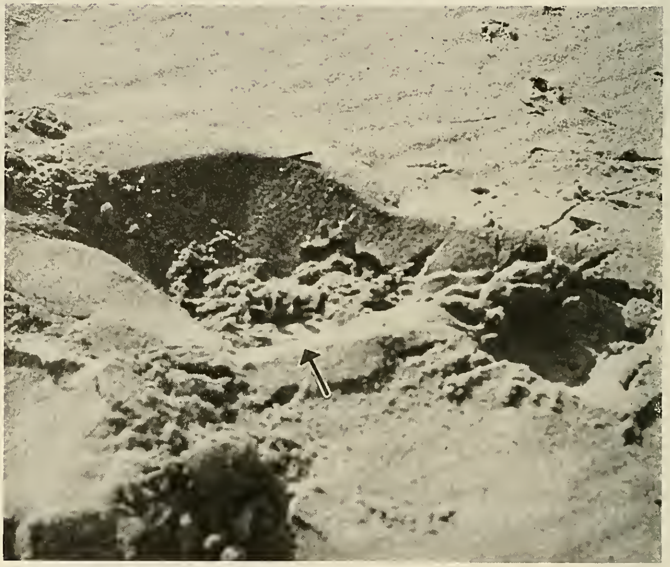


Many insects wear a garb suited to concealment in the position they customarily assume. The caterpillar of the Luna moth, shown here, has body markings suited to its inverted position on the twig



◀ THE GHOST CRABS that scamper over a sea beach vanish as soon as they stand still if the light is soft. But sharp shadows make them more conspicuous, and . . .

▼ . . . it is their habit to bury themselves in the sand until only the eyes show

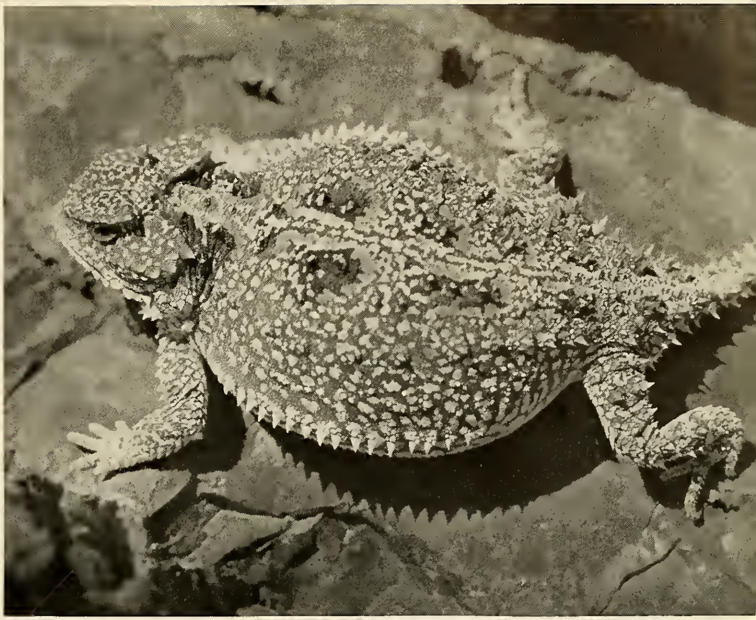


ground if it is to remain safe. A green katydid on a scarlet poinsettia leaf would be almost as conspicuous to us as a crow on a snowdrift. The katydid must stay among *green* foliage to escape animals that have color vision. Even a brown, leafy background would destroy the illusion. The pale tiger beetles, the grayish-white spiders, the ghost crabs that scamper over a sea beach vanish as soon as they stand still. Beebe referred to them as "autochthones . . . that . . . drifted about like sand - grain wraiths . . . And when they did move, recognition usually came too late to some fly, which had trespassed on this littoral hunting ground."

The degree to which an animal matches its background is sometimes spectacular. One of the most famous areas where this can be strikingly observed is within a few miles of the site of the first atomic bomb test, in the White Sands National Monument, near Alamogordo, New Mexico. On this strange series of glistening gypsum dunes grow a few yucca plants and a scattering of other herbs. But types of lizards and even insects that are dark in color on land immediately surrounding the White Sands National Monument are represented on the gypsum by white individuals. These scamper from clump to clump of yucca or alight on the dunes and disappear by camouflage.

Even the New Mexican pocket mouse, *Perognathus intermedius,* displays this extraordinary lack of coloration. The individuals on the sand are almost pure white, though they are not albinos since their eyes are black. Those on surrounding rocky soil—the normal habitat for this little rodent—are brown. And close by, on black beds of lava deposited in the not-too-distant past, a third color phase of this same pocket mouse is uniformly blackish except for the pale paws. Other than in their color, no differences have been detected between these representatives of the same species. Like the distinctive grasshoppers that click in the air over each of these three types of terrain, each has achieved an almost perfect match for the very different types of background. The relatively recent origin of these dunes and lava beds gives us pause. It indicates more rapid adaptation in the animals there than might be supposed possible from other illustrations.

Difficulties still confront the animal that duplicates its environmental background. Sunlight brightens its back and casts shadows below its body. To compensate



➤ The Horned Toad's sawtooth shadow is very conspicuous here. But in its sandy domain it buries its fringes so that shadows and underparts disappear

for this inequality, countershading has developed on many animals. Their backs are darker than the surrounding landscape, and the shine of sunlight there provides no warning clue. Their bellies and flanks are pale, but because these parts receive less illumination, they reflect a matching tone. When you look down upon the black or brownish back of a fish in deep water, it is barely visible against the background, whereas its silvered belly will show a minimum of difference to eyes looking skyward from below. The sides are gradually countershaded, thereby reducing visibility from the side. Only when such a fish swims over a sand bar does it become obvious. Then it stands out sharply from the bottom for any kingfisher to see, while the added light reflected from the sand brightens its undersurfaces until they, too, no longer match when viewed from any angle.

Solely in customary surroundings and illumination is countershading effective. Conventional positions for the body are required also. And animals that regularly spend their lives inverted, like the sloths in tropic trees, are usually pale along their backs and dark over the surfaces they hold toward the sun. The same arrangement is seen among certain bugs, as for example in the back swimmers (*Notonecta*) and in the small crustaceans known as *Scapholoberis*. Often an upside-down habit can even be predicted simply from the examination of such a creature. Thus the Luna and many sphinx moths have caterpillars that are dark green along legs and undersides and pale greenish-white along the back; and if you watch them, you will see that they *do* cling below the leafy twigs on which they customarily browse.

Shadows

A creature that matches its background perfectly may still be obvious on a smooth stretch of sand or a clean tree trunk or leaf, because its shadow traces a telltale black outline around one side. Ghost crabs on a beach would often be almost invisible as they rear high on eight bowed legs except for the conspicuous shadow they cast. Artists often employ shadow lettering in advertising copy, and we read the word that isn't there. The shadows alone enable us to imagine the raised letters. To eliminate its shadow is therefore part of an animal's problem in self-concealment.

Perhaps the simplest way that animals hide their shadows is by squatting or lying at full length on the smooth surface—spreading their bodies and pressing flattened edges against the terrain. Horned toads bury their fringes under the sand, so that shadow and underparts disappear together. The badger's broad, flattened body helps it vanish in a field. Moths on bark employ the same procedure. Ghost crabs quickly twitch their legs and sink their bodies and appendages into the beach until only upright brown eyestalks remain exposed to watch pursuers pass them by. A few lizards and fishes even have extra frills along the sides of the body and tail, which spread out on any supporting surface and eliminate shadows.

In spite of perfect countershading and shadow elimination, the change of seasons can upset camouflage. Thus the snowshoe rabbit must be white in winter and brown in summer. The weasel that follows the rabbit fears the hawk, and except for a jet-black tip to the tail, it turns to ermine white when snow begins to fall, then to an earthy brown when the spring sun melts through to the ground again. The transition periods may be dangerous ones but not for the ptarmigan, whose feathers provide perfect matching throughout the year. In winter, every feather is pure white, but as rocks and moss begin to project through the snow, little patches of brown feathers appear in the plumage. The last few white feathers are shed as the snow vanishes. The reverse sequence protects the

SHADOW
SHADOW

Shadow alone can serve as identification

ptarmigan in the fall. Such changes are needed where seasons are so different. But in Florida and other snow-free states, rabbits and weasels replace their summer fur with winter pelage of the same brown color.

The advantages of matching a background in tone are evident even after dusk, when day vision ends. Color is no longer operative: "At night all cats are gray." Yet owls and other night hunters recognize their prey by sight as well as by sound. A contrasty target scampering across a starlit field is far easier for them to catch than the same sized object camouflaged to match the terrain. Scientists at the University of Michigan tested this in the laboratory and showed that white mice on dark loam or black mice on pale sand lost their lives to a hungry owl long before the ones that suited their background.

The less distinct the contrast between an animal and its background, the closer a naturalist or enemy must come in order to detect its presence. The accompanying diagram demonstrates this principle.

Another way of expressing it is to say that the ability to discriminate contrast depends upon the proportion of the total scene that the object occupies in the observer's eye. Thus if an animal is farther off, it does not need to match its surroundings quite so faithfully to escape detection. Even a large number feeding together in the distance blend sufficiently to disappear.

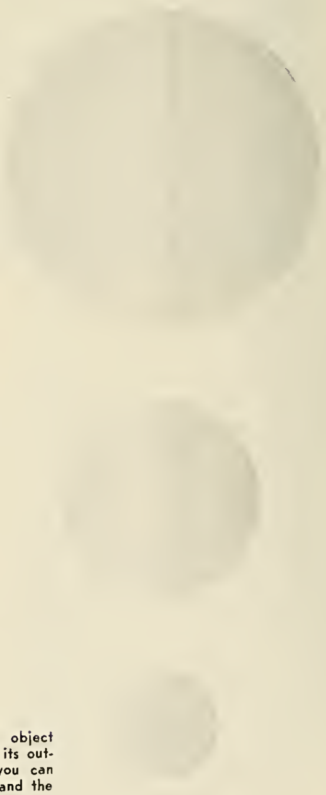
A striking example of the opposite effect is provided by the Texas bluebonnet. In spring, when carpets of this handsome lupine stretch to the horizon, open woodlands take on a new and startling depth. Under the trees the soft yet brilliant blue extends into far vistas. Perspective shrinks the upright trunks to matchstick dimensions; the bluebonnets go on and on like an azure sea. Yet only a week before, the green of lupine leaves and buds blended with the green of the trees to hem in the scene. The lack of contrast and the loss of detail through distance gave no notion of how far the eye could see. The yonder, without bluebonnets, had disappeared through camouflage.

The Texas scene is a revelation that depends upon color vision. No black-and-white photograph shows the effect adequately. However, many creatures do not possess color vision, and the role this ability plays in natural camouflage lies beyond the scope of the present article.

Control of Pigmentation

Still another type of camouflage is found in certain fishes. In the surface layers of their skin are star-shaped cells containing pigment. In some, most of the pigment is black. This is the case in those common little catfish known as bullheads or mudpouts. The pigment is under nervous control and can either be collected together in the middle of each cell or spread out into the many branches. If concentrated, the tiny black dots can be seen only with a microscope, peppered at intervals over the fish's body. The pinkish-whiteness of the skin shows clearly, and the overall effect is white. But if the pigment is dispersed, it renders the whole exposed area of the cell a deep black. The overlapping extensions of the many cells effectively cover the body surface, so that the over-all effect is black. The change from concentrated pigment to dispersed pigment may require less than a day. It depends chiefly on what the fish sees. If a mudpout is placed in a black tank, it, too, soon becomes black. If another mudpout is in a white tank, it becomes white. If both are now transferred to a gray tank, both adjust themselves to match the new environment.

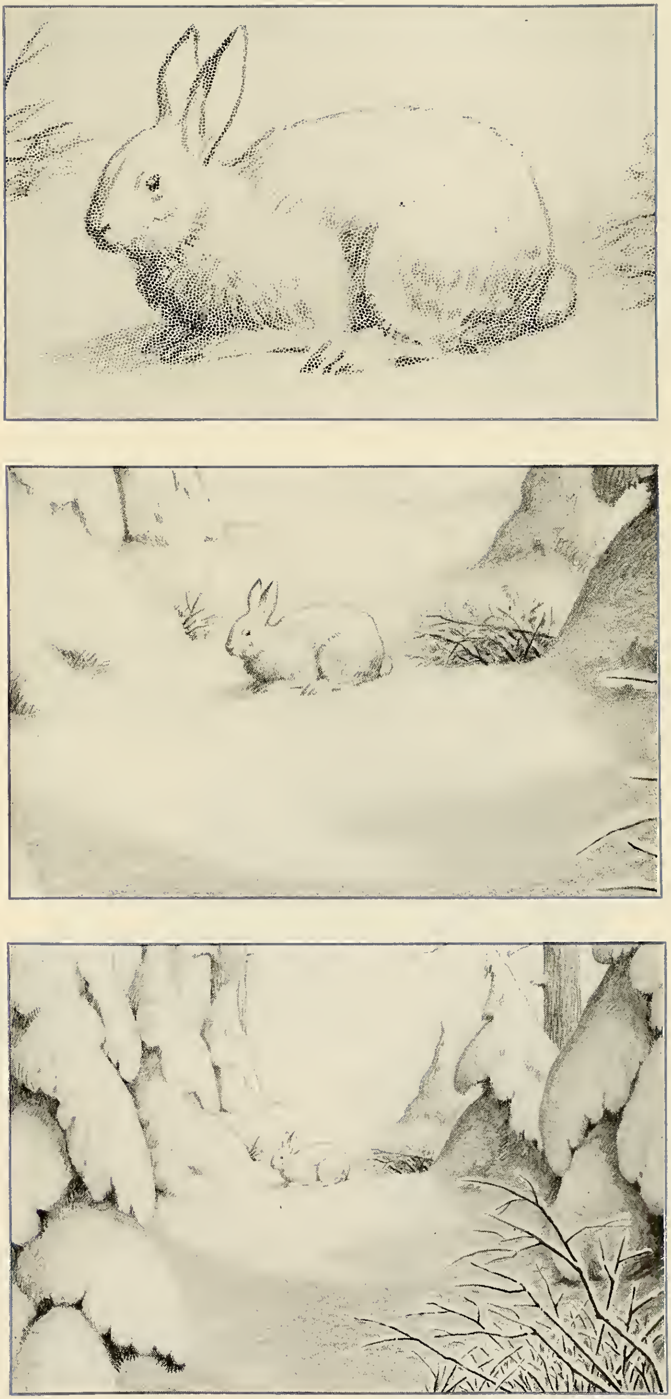
Perhaps the ultimate in this direction is the ability of the flounder and its flatfish relatives, the turbot and halibut. These fishes lie on the bottom, on what originally was one side of their bodies. The young fish has a more normal shape, but one eye migrates to the upper surface as the fish grows. This, together with a strange twisting of the mouth, allows the fish to operate in a seemingly lazy position. But again the eyes and pigment cells on the upper surface are intimately related. Unlike the mudpouts, however, a flounder has in addition to black pigment, a white, a yellow, and a brown—all in an irregular pattern. And not only are the dif-



When there is little contrast, the size of the object determines whether you will be able to discern its outline. Note the comparative ease with which you can distinguish the two halves of the larger circle, and the increasing difficulty as the circle becomes smaller ferent colors under individual control, but even the areas of that uppermost surface are regulated separately. Thus if a flounder is on a sandy bottom, the over-all tone of the pattern matches the brightness of the sand—whether white coral bottom or muddy gray sand or black volcanic particles. The pattern of the pigment also matches the coarseness of the sand by being very minutely speckled. If the flounder is on gravel bottom, on the other hand, specklings on the back are coarser.

The ability of the flounder to match the background seen with its misplaced eyes was investigated by the late Professor F. B. Sumner at the Scripps Oceanographic Institute in La Jolla, California. He placed the fish in special tanks with linoleum patterns for background and recorded photographically the accuracy with which the creatures matched the sequence and coarseness of the squares of black and white on which they lay, quietly waiting for food to swim within capturing distance. If the fish moved, its pattern soon adjusted to the new locality on the linoleum. If transferred to a tank with a different bottom design, the body pigment cells performed again.

A person can but wonder how many thousands or millions of generations were required for these various complex adaptations to reach their present perfection. A slight advantage in terms of survival must have been the test of their permanence, for the less effectively hidden individuals were not so likely to live to produce their kind. Of course, camouflage alone is not enough to guarantee success in the struggle for food and mates. In fact, it would be disastrous for an animal to be so well concealed that its mate could not find it! Yet among the many curious ways in which animals are adapted for success in life, camouflage is one of the most fascinating. It is also a study in which a great deal of valuable information can be added by interested observers.



Since apparent size is dependent upon distance, an animal does not need to match its background so closely if it keeps far from other creatures

HIGHBOYS

Meet the incredible giraffe — an animated watchtower that has difficulty coming down to earth for a drink and sometimes lets its curiosity get the better of it

By Ken Scott, Jr.

General Curator, San Diego Zoo

THEY stood browsing among the acacias, their spotted, sinuous necks arching above the trees. Gray tongues, wet and serpent-like, sought out the freshest, tenderest leaves and tore them from the branches. Tufted tails switched languidly from side to side. Even though my car was now only 200 yards from where these animated skyscrapers were stripping their lunch from the trees, they seemed entirely unaware of my presence.

The scene had an air of unreality about it, a stark sort of unreality that sprang, oddly enough, from familiarity. Although I had never laid eyes on the spot before, I knew it as well as my own street and number. It was a museum diorama come to life, and I had seen it in replica a hundred times before, as it waited eternally for the subtle touch of life.

Now, here before me, it breathed and moved and whispered — the golden infinity of Kenya's Athi Plains, the parasol-topped trees with their sparse, thorny foliage, the zebras, the wildebeests, the "Tommies," and — the giraffes!

The giraffes were hardest of all to accept as living flesh and blood. Yet there they stood, placidly munching away on acacia leaves with no inkling of the awe I felt.

Giraffes had long been favorites of mine in the San Diego Zoo, ever since, in fact, we had received our first pair in 1938. I had seen giraffes in circuses and other zoos before, but, when our own zoo specimens emerged from the crates in which they had been shipped from Uganda, I felt certain that nowhere in creation could there be two more beautiful creatures than these, smudged and travel-weary though they were.

I marveled at their towering height and the fluid grace with which they glided in their pacing gait; at the quiet dignity with which they accepted the first uncertain ministrations of their new keeper; and perhaps most of all at the disarming, soul-searching quality of their gentle brown eyes. My reaction was an immediate attachment, and it is one from which I have never recovered. The novelty of having a pair of giraffes in our own zoo soon wore off, but the affection and interest I originally felt for them has grown conversely, multiplying many times over with the birth of each new infant calf to the adult pair.

The same attachment, I found, held true for the wild giraffes in Africa. Unconfined by museum glass or zoo barricade, they were more amazing, more wonderful than ever.

The first group I saw was a small one, just inside the gate of Nairobi

◄ The graceful giraffe lives peaceably with its kind and bears no ill-will toward other types of animals. Its disarming, soul-searching, gentle brown eyes endear it to the zoo keeper, though it can "kick in all directions at once"

Photo by Quentin Keynes

Photo by Quentin Keynes

▲ Silhouette of Africa: giraffes browsing on the Athi Plains in Kenya Colony. The tallest living animal symbolizes Africa more than any other big game animal, for nothing like it roams any other land

National Park on the Athi Plains. There were four of them: a bull, two cows, and a half-grown calf; and I came upon them while they were in the midst of their lunch (both figuratively and literally speaking). They fed from the crown of the same tree, spaced at intervals around it like any family foursome about the dinner table.

Behind them in the distance lay the outskirts of Nairobi itself, and only a few hundred yards away traffic bustled up and down the busy Magadi Highway. The proximity of civilization had little apparent effect on them. It was obvious that the protection they had enjoyed for a number of years had won their confidence to an astonishing degree.

As my car crawled toward them, they paused in their feeding from time to time, rearing their heads briefly before resuming their meal. Their curiosity was at first quite casual and only momentary. But as I drove closer, they watched more and fed less. Finally, with an air of, "Oh, well, we were through eating anyway," they sauntered off.

A short distance away, they stopped and turned and stood watching me. Patiently, they chewed their cuds and awaited my departure with a concern that was due more to annoyance than to fright.

As often as possible during my stay in the Nairobi area, I drove out to the park, which, conveniently enough, is situated only a few minutes from the center of town. On each occasion, I found the same giraffe family, and they were never far from the acacia clump near the park entrance. That first meal was not the only one I interrupted, but sometimes my visits were more conveniently timed. I often saw them in the open, half asleep and drinking-in the morning sun, and sometimes I came upon them standing in the road.

Fortunately both for them and for the motorists, the speed limit in the sanctuary is fifteen miles an hour, a pace that gives the giraffes ample time to make a graceful exit. On the open highway where speed is unlimited, giraffes constitute a considerable hazard, particularly at night.

I was to see many giraffe herds during the ensuing weeks, but I never came upon a group without experiencing that initial reaction of combined awe and incredulity. I am still almost ready to agree with the man who insisted, "There ain't no sech animal!"

The giraffe observations and notes I had opportunity to record in Africa could in no way be construed as scientific studies. But in reviewing them, I find that, sifted and unscrambled, organized and digested, they do perhaps provide a key to the character and behavior of this unique creation of nature. Certain traits, I find, are referred to over and over again, so repeatedly in fact that one cannot help drawing certain general conclusions. And of these traits, the giraffe's *laissez-faire* approach to living tops the list.

There exists no less offensive a beast than the giraffe. It lives peaceably with its kind for the most part and bears not the slightest degree of ill-will toward other kinds of animals—both of which, as character recommendations, are more than can be said about the majority of people! Yet despite such inoffensiveness (or perhaps because of it), the lofty giraffe is sometimes an underdog. Because of its size, its enemies are naturally few in kind, but what they lack in variety they make up for in violence—and Man heads the list.

For some unaccountable reason, the giraffe is a favorite of trophy hunters. Its head, stuffed with papier mâché and a pair of glassy, expressionless eyes, decorates many a sportsman's den—and I use the word "sportsman" loosely, since walking up to a giraffe in the field and dropping it in its tracks must involve all the excitement and danger of bagging a Jersey heifer in a dairy yard.

Both the lion and the leopard occasionally kill giraffes, but they do it merely to appease their hunger. A single giraffe can provide a hearty meal for an entire pride of lions as well as the jackals, hyenas, and

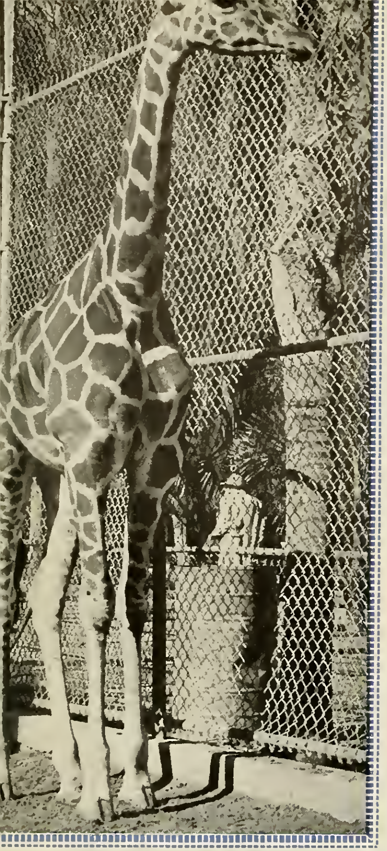


Photo by G. E. Kirkpatrick

▲At zoos the giraffe is always a favorite attraction. The animal is well known for its curiosity about everything, including people

vultures that move in as soon as the big cats have eaten their fill.

A giraffe has no means of defense unless, as one zoo worker put it, you say it is the only animal that can kick in all four directions at the same time. While this statement is a slight exaggeration, it is nonetheless true that anyone working with a giraffe in captivity had best keep an eye on its hoofs or he is likely to be reminded of them in a most disconcerting manner. In the wild, a hunter never gets close enough to a giraffe to be in a position to worry about being kicked.

The giraffe's horns, small, knob-tipped and hair-covered, are of little value in defending their bearer against predators. To my knowledge, the only use to which they are put is in the occasional combats that occur between two males. At such times, one male lowers his head and shoves his horns between the forelegs of the other. Then, with a mighty heave, he rears his head, attempting to throw his adversary back on his haunches.

The long neck of the giraffe, incredible though the contention may seem, contains exactly the same number of vertebrae that grace the human neck. There are seven of them, but the degree of their elongation is without equal, and they serve their bearer in good stead.

The giraffe's neck constitutes a watchtower. This, combined with excellent vision and a good sense of smell, enables the animal to observe potential danger from a considerable distance. Unfortunately, the giraffe's judgment as to what constitutes potential danger and what does not is poor. Being cursed with an innate and irrepressible curiosity, the giraffe is often attracted by something that should scare the living daylights out of it.

This foolhardy characteristic is particularly evident in young animals. I have watched a mother giraffe pace excitedly back and forth while her precious calf edged closer, step by step, to where I stood motionless. No amount of snorting or head tossing by the alarmed parent had the slightest effect on the youngster, and only some slight but sudden movement on my part sent it rocking home to mother.

Among the most remarkable habits ascribed to the giraffe is that of the communal nursery. Some authors discredit the story entirely, describing it smugly as an old wives' tale. However, I have seen a single, mature giraffe cow surrounded by as many as nine youngsters, all under a year old—with not another adult giraffe within a mile in any direction. The gestation period of a giraffe is approximately fifteen months, and only one calf is customarily born at a time—never more than two. Since "novemtuplets" would be entirely out of the question, the only explanation I can offer for such an aggregation is the communal nursery theory.

Giraffes are generally sociable animals, with only an occasional misfit who appears to live alone and like it. Giraffe herds may include anywhere from half a dozen individuals to a hundred. The largest herd I observed consisted of approximately seventy members.

This group was led by a magnificent, black-spotted bull. His neck was thick and muscular, and his forehead bulged with the protuberances that characterize most mature giraffe bulls. There were several other bulls in the herd but not one that even began to rival him in height, bulk, or coloration.

Yet impressive though this monster was, he was still not the most noteworthy member of the herd. That distinction belonged beyond doubt to a small and rather puny individual.

It was an albino, with reddish and poorly defined spots and interspaces of dusty white. Because of its poor vision, the albino always sought the center of the herd, apparently depending upon the behavior of the other animals to warn it when danger was imminent. Try as I might, I could not approach it closely enough to obtain a satisfactory picture. Invariably it was surrounded, and sometimes completely hidden, by its herdmates.

The herd permitted me to walk within 300 or 400 feet of its outermost member. At this distance, however, the entire group began to move away. The retreat was executed not hurriedly, not nervously, but with a leisurely dignity. Only the leader remained steadfast, standing broadside and outlined against the sky like a massive statue. Finally, when he appeared to be satisfied that his compatriots had retreated to a safe distance, he too walked sedately away, serving as rear guard.

Giraffes are strictly browsing animals, feeding from the tops of acacias and other trees and shrubs of a convenient height. Their table manners are beyond reproach and quite in keeping with the graceful behavior that generally characterizes them. Drinking, however, is another matter.

When a giraffe drinks, it is forced to toss both grace and caution to the winds. In lowering its head to the water level, it becomes the ultimate in awkwardness. Sometimes it spreads its forelegs, stiffly and straight, at right angles to one another, and shifts its front feet farther and farther apart in shuddering jerks until at last it can reach the water. At other times it places the feet slightly ahead of the body and bends its forelegs forward and down, spider fashion, until the head is low enough to reach the water. In either case, the process is a slow and uncertain one. And once the animal's thirst is slaked, the recovery of its normal standing position is just as awkward.

Consequently, the giraffe is understandably reluctant to visit the water hole and does so only when it is absolutely certain that no danger lurks near by. If some strange scent disturbs the giraffe as it approaches the water hole, it refuses to drink until the scent is gone or its thirst becomes unbearable. It subsists in the meantime on what scant fluids it can glean from its food. Like the camel, the giraffe has been accredited with remarkable powers of abstinence. It can forego drinking for 40 or 50 days, or so the story goes! Such reports come under the heading of gross exaggeration, but it is safe to say that the giraffe may, and often does, go several days without water.

Of all the myths concerning the giraffe, that which is most commonly repeated and most widely believed is that the creature is mute—that it lacks any vestige of vocal equipment. This is far from the truth, for the giraffe does have a larynx—a poorly developed and seldom utilized one, to be sure—but still a larynx. So far as I know, there are no authoritative reports of the vocalizing efforts of wild giraffes, but zoo specimens have been heard to "moo" softly. Thus, as Mr. George G. Goodwin of the American Museum has been quoted as saying, the giraffe is not mute, it is merely reticent.

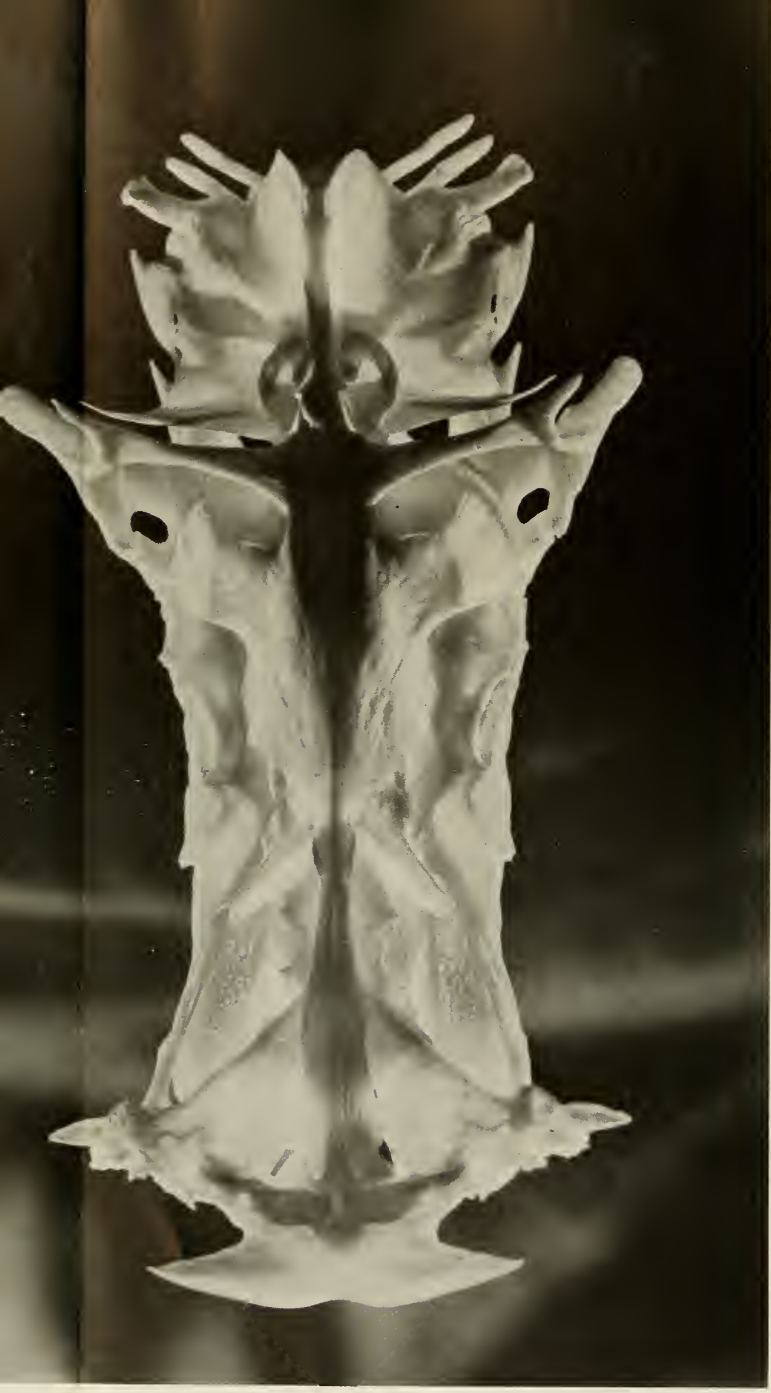
There are several easily distinguishable types of giraffe. There is the Masai giraffe, with its brown maple-leaf blotches against a background of beige. Then there is the reticulated or Somali giraffe, with its red coat and network of immaculate white. And the Uganda giraffe has three bony protuberances in addition to the two bonafide horns, which have caused it to become known as the "five-horned" giraffe. Each of these and half a dozen other described forms have some individual claim for physical distinction. But whether the various forms are merely local races or constitute valid species is a matter worthy of considerable research.

The problem, however, is one that concerns only the taxonomist. As far as the African tourist is concerned, a giraffe is a giraffe, and nothing else matters. Here stands a creature that symbolizes Africa perhaps more than any other of the Dark Continent's big game mammals. Nothing like it roams any other part of the world. It is and has been, throughout historic times, confined to Africa.

The late Martin Johnson, in selecting a color scheme for one of his amphibious planes, chose a giraffe-hide pattern. The choice was not the result of a mere whim. The plane was to be christened "The Spirit of Africa," and what design could be more appropriate than that of the giraffe!

▼ A Uganda giraffe with her newborn calf. The female bears only one calf at a time—never more than two

Photo by G. E. Kirkpatrick



▲ THE REPLICA of the crucifix, complete with halo, is on the underside of the skull. Venerated for centuries, these skulls are sold in curio shops around the Caribbean. The authentic dissections from which these photographs were made represent the artistry of Mr. Theodore I. Schneider. Mr. Schneider undertook this exacting work as a hobby, but he became so distinguished a master of it that the American Museum is privileged to have several examples of his work among its exhibits

The Cru

Every sea catfish carries in i
of the Easter Season, which
gious lore of many peopl

By N. J. BERRILL
McGill University

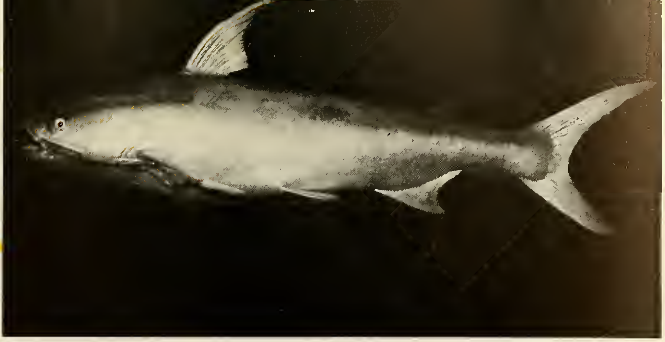
COLUMBUS was a deeply religious man. When he crossed the ocean for the third time, the first land he saw he named Trinidad after the Holy Trinity. Some days later his ship sailed past the mouth of the Orinoco into the Gulf of Paria. Fish of many kinds were caught and eaten, and the sea catfish was certainly among them. But the heads and bones must have been thrown away, for Columbus by this time was convinced he was getting close to the lost Eden, the Earthly Paradise, and he would not have overlooked the Sign of the Cross. Had he himself seen the skull of the Crucifix Fish, surely his mood would have prompted him to speak of it in his letter to their Royal Highnesses.

In any of the coastal towns of South America and through the West Indies you can find these skulls in any curio shop. People are said to hang them on the wall in place of a crucifix, and they have been venerated for centuries as charms against danger and sickness. The lower jaw is not included. If you hold the skull in your hand with the underneath side uppermost, the bones of the roof of the mouth form a crucifix. The cross is there, and so is the figure of Christ. You may even discern what looks like a crown or halo.

Once the symbol of the cross itself was recognized, almost every other bone in the skull was brought into the picture. The peculiar bones that look like the halo have also

ifix Fish

head a remarkable reminder
ures prominently in the reli-
n northern South America

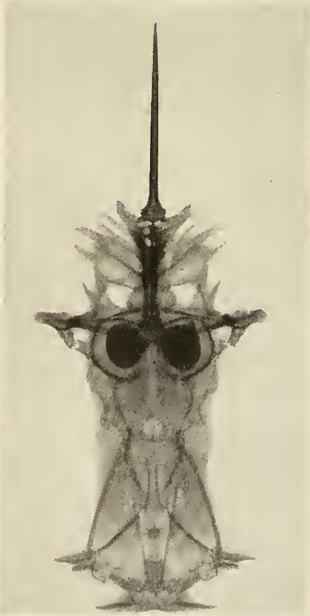


▲ Nothing in the external appearance of this bewhiskered fish would suggest the hidden beauties of its internal architecture

been interpreted as the steps to the cross. If the skull is turned over, you see the breastplate and the spear of the Roman soldier; and if you shake the skull, you hear two objects inside rattle loudly — the dice with which the soldiers cast lots for the garments of our Lord. An account of the fish written in 1789 states that "when the bones of the head are separated, each represents some one of the instruments of the Passion of our Redeemer, forming spear, cross, nails, etc." Others have seen the upper side to be a hooded monk with outstretched arms.

Such is the symbolism. How, then, do these strangely shaped bones serve the fish? The robes of the monk are the skin bones of the head fused together to protect the underlying brain. The two largest spaces between the skirt of the robe and the feet of the monk are where the organs of smell lie tucked below the surface. The post of the cross is the solid axis underlying the brain and extending the rigid axis of the head to the snout itself.

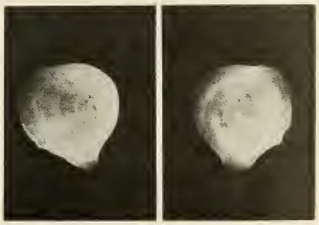
When the skull is shaken, the dice rattle. These are the ear stones, or otoliths, hidden away in their boxes just below the arms of the figure. Bone must be cut away to get them out. As ear stones they serve the fish as part of the mechanism for static balance. They are loose, but they grow as the fish grows, fast in summer, slow in winter, so that when they are cut through they show annual rings like tree rings, indicating the age of the fish.



X-ray by Dr. Sidney Rubenfeld

◄ When the skull is shaken, there is a loud rattling noise, caused by two ear stones, which have been interpreted as symbolizing the dice with which the soldiers cast lots for the garments of Christ. The ear stones can be seen as two dark spots in this remarkable X-ray photograph

▼ Though the ear stones are loose in their capsules, they grow as the fish grows, forming annual growth rings somewhat like those in a tree. These were taken from a fish 4 or 5 years old

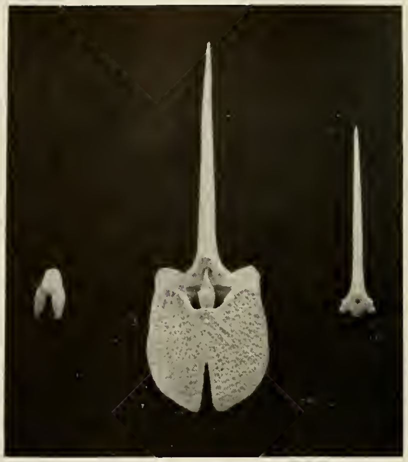


The halo consists of three pairs of bones, although one pair dominates. These are the Weberian ossicles, so-named after their discoverer, and they act as a chain of bones connecting the air bladder of the fish with the back of the ear cavities, in the same way that the hammer, anvil, and stirrup in our middle ear connect the eardrum with the sense organ itself, the inner ear.

To speak of the ear is a little confusing, for in our own case and that of all land vertebrates the ear is a double organ, part for balance and part for hearing. The fish lacks the hearing part as we know it. But catfish and their closer relatives have independently evolved something comparable to it. The ossicles have been made, long ago, from parts of vertebrae of the neck, and they connect the ear capsules with the air bladder, so that a sense of hearing of a kind has been added to the organ of balance. Recent experiments, in which loaches were made to respond to a dinner bell, flute, or other sound, suggest that fishes detect water-borne vibrations, whether they be called "sound" waves or not.

Most zoologists believe that the

➤ SYMBOLS of the spear and breastplate of the Roman soldiers have been seen in the movable spine that supports the fish's dorsal fin and in the shield-shaped bone at its base. At left, you see a small sliding bone that works like a bayonet lock to keep the spine in an erect position. At right, in this illustration, the spine is removed from its base



▲ THE SKULL with the spine raised

air bladder of a fish was originally one of a pair of lungs such as the lungfishes retain to this day. In most bony fishes the bladder is completely sealed off from the outside of the animal and functions as a hydrostatic organ. Some fishes, however, have stopped short of this, and in the catfishes especially, which include the Crucifix Fish, the bladder keeps its open connection with the throat. Now, while the air bladder probably has its hydrostatic function, the open tube enables the fish to grunt. This, in its own way, is a voice. But it is very difficult to discover how much this organ may be used to call other catfish, especially during the mating season, and how much it may be used to register changing pressure related to the depth of the fish in the water.

Turning again to the upper side of the crucifix skull, we have left the breastplate and the spear. The breastplate is another skin bone. It extends backward from the skull and serves partly to protect the animal. But it also provides attachment for part of the great muscle system that brings about the swimming movement of the body. It is more than that, however, and here we need to look at the fish from the side and more from the point of view of a sailor or fisherman.

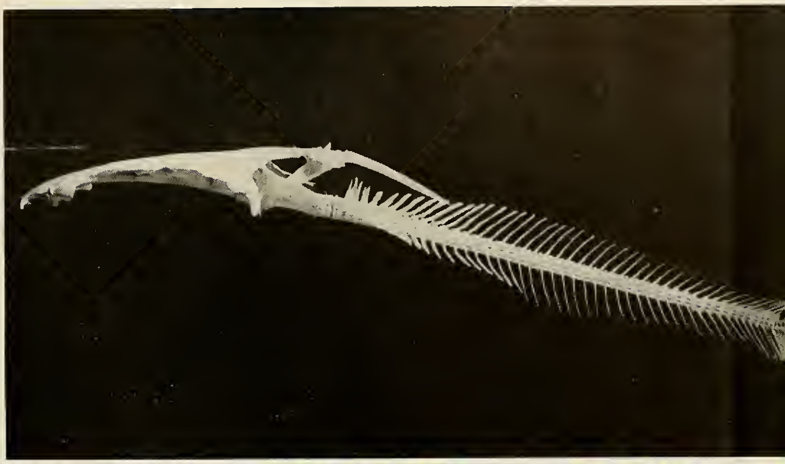
The Sea Catfish has another name, more akin to the sea and ships and the wind than to the mystic symbolism of the Christian Church. It is the Gaff-topsail Catfish, and according to the Oxford Dictionary, a gaff is a "spar extending the top of a fore-and-aft sail not set on stays," a spar that can be raised and lowered.

The spear is the gaff or spar and is actually a great dorsal spine that forms the fore-edge of the dorsal fin or topsail. The muscles that raise or lower the gaff pass down between the prongs of the breastplate and are attached to the sturdy growth of bone that rises from the back of the lower skull to the breastplate like a mast between decks. A short spine in front, at the base of the long spine, is "a nail of the cross" and acts as a stop to prevent the gaff from tipping too far forward.

◄ FROM SPRING UNTIL SUMMER, the father fish carries the eggs in his mouth, as shown here. His appetite disappears, and the young fish swim around in his mouth until they are about four inches long

Like the catfish of the rivers and lakes, sea catfish stay close to the bottom, grubbing along with barbels or whiskers probing and trailing, sensitized both by touch and taste to detect edible morsels. They stay close to the coast and frequent the estuaries and bays and mud flats near the mouths of rivers — regions where water is generally murky with suspended mud. Living as they do, sight is of no more value than other senses, and taste and touch loom as large in the brain as on the face.

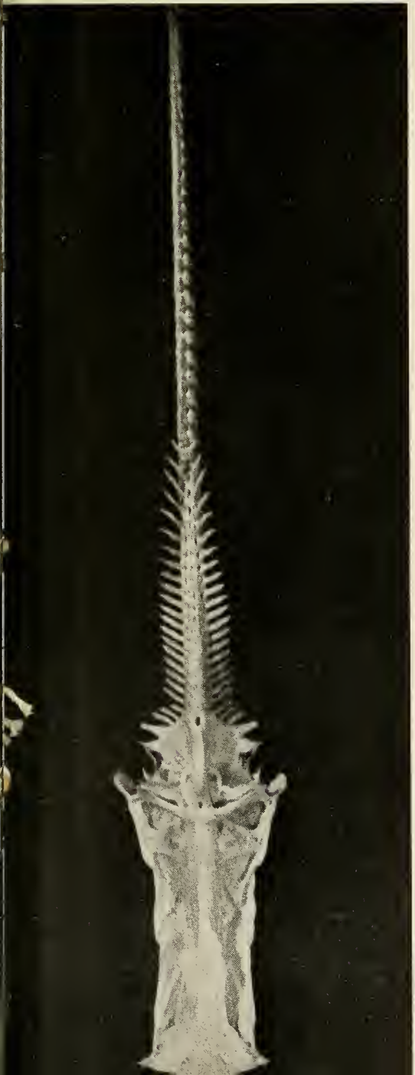
Living as they do, these fish have special problems in reproduction. Muddy water is no place for fish fry to find the special small food organisms they need, and a mud bottom is a hopeless place on which to deposit eggs. So catfishes of all kinds, in the course of time, have done something about it. According to Dr. E. W. Gudger, the first steps can be seen in the common yellow catfish of the rivers. Their eggs are large, as fish eggs



▲ WHEN LOWERED, the spine lies parallel to the fish's back just behind the neck

go, and they are laid in a sort of nest. But this alone is not enough. The parent keeps the water in movement, and as a final and potent gesture, the male periodically takes the developing eggs into his mouth and then blows them out with some force, keeping up the practice until the fry can swim freely. In this way they are kept clean and healthy, and at the same time the father realizes an instinctive paternity and refrains from swallowing his offspring.

So much for a river catfish. When it comes to a question of laying marble-sized eggs on marine mud flats, the problem becomes greater, for in addition to the smothering mud is the even greater menace of the voracious blue crabs. Therefore, sea catfish and some others have pushed paternal care to the limit. The Gaff-topsail of the Atlantic coast is typical. The eggs are golden yellow and average about three-quarters of an inch in diameter, and the female lays anything up to about seventy of them. These are large eggs from any point of view, and they can develop into small fish two inches or more in length before feeding becomes necessary. So if they can survive at all, they get an extremely good start in life. But the larger, more obvious, and heavier the eggs, the more protection they need, and in this case the male takes them into his mouth after they have been fertilized and for about ten weeks thereafter becomes a veritable perambulator. His mouth enlarges in anticipation of the nursery it has to be, and his appetite disappears entirely. Then, from spring into summer, the developing eggs are kept safe. They hatch when the embryo is about an inch and three-quarters long, but even then they stay within the bounds of safety. Dr. Gudger believes they feed on the microscopic crustaceans drawn into the father's mouth with the water he takes in for breathing. Apparently the young fish filter them out by their own finely-set gill rakers, for they do not leave their father to live their own lives until they have spent some weeks skating and swimming around in the mouth cavity and have grown to a length of about four inches! Then presumably they are fairly safe, even from their more or less cannibalistic mother, and once again the father can recover his desire for food and go about his own respectable masculine business.



◀ THE CRUCIFIX is located on the underside of the skull, with the arms of the cross near the neck

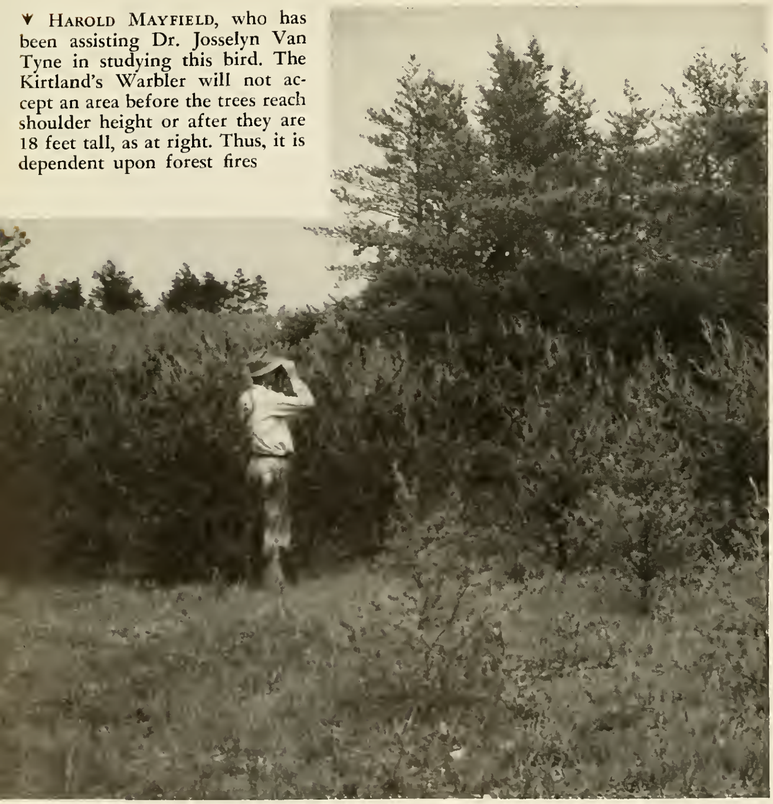
The Bird that Baffled a

For half a century, bird students wondered where the Kirtland's Warbler disappeared in summer to lay its eggs

NORTH of Muskegon, we pulled off the highway and into a tourist court set among oaks near the eastern shore of Lake Michigan. We were less than half a day's run from the jack pine barrens of north-central Michigan, home of the Kirtland's Warbler, that rare and restricted bird we had driven a thousand miles to see.

That evening my wife and I thumbed once more through our bird guides, memorizing the habits and field marks of this songbird of the jack pines. Only in Oscoda, Crawford, and Iosco counties—with scattering records from adjoining counties; only in an area about 60 miles across and 100 miles long; only here, in all the world, is the Kirtland's Warbler known to nest. It breeds in the sandy jack pine barrens where new trees have sprung up in the wake of a fire. Not until these pines are five feet high do the warblers accept an area; as soon as the trees reach about eighteen feet, they abandon it. Thus each successive area is acceptable as a breeding ground for only about fifteen years. The Kirtland's Warbler depends, literally, upon forest fires for its nesting sites.

▼ Harold Mayfield, who has been assisting Dr. Josselyn Van Tyne in studying this bird. The Kirtland's Warbler will not accept an area before the trees reach shoulder height or after they are 18 feet tall, as at right. Thus, it is dependent upon forest fires



The riddles surrounding the life of this curiously restricted bird have stirred the interest of ornithologists ever since it first became known to science in 1852. On May 13, of the previous year, Charles Pease shot a small bird in a treetop near Cleveland, Ohio. The little migrant was unknown to him and also to his father-in-law, Dr. Jared Potter Kirtland, a Cleveland physician and naturalist of national standing. The bird was named *Sylvicola kirtlandii*, in honor of Kirtland, by Dr. Spencer Baird, Secretary of the Smithsonian Institution, in Washington, D.C. This has since been changed to *Dendroica kirtlandii*. The Cleveland physician, a friend of Agassiz and other celebrated naturalists of his time, also had his name bestowed upon a mollusk, a snake, a fossil plant, and a town. Kirtland, Ohio, a community east of Cleveland, derived its name from the same source as the Kirtland's Warbler.

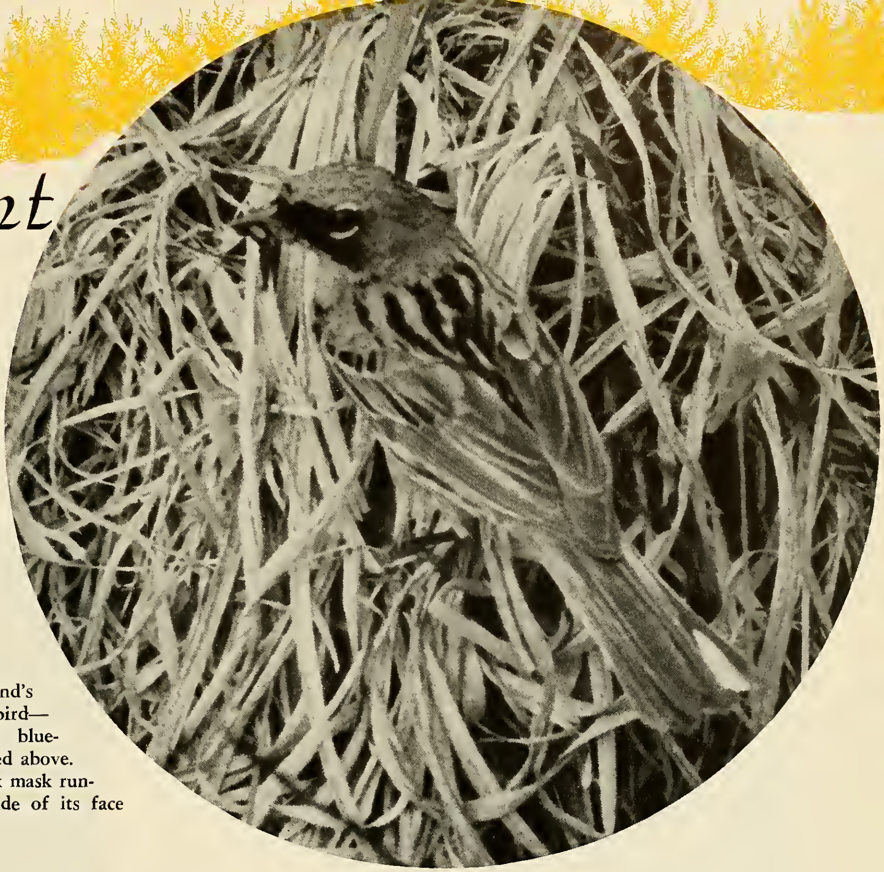
About a decade after the first specimen was collected, a second one was taken—also at Cleveland. Then, in 1865, Dr. Baird made a surprising discovery. In checking over some specimens collected by S. Cabot, Jr., on a voyage to Yucatán, he came upon the skin of a Kirtland's Warbler. It had been shot at sea, near the island of Abaco, in the Bahamas, about 1840. This was a dozen years before the type specimen had been collected near Cleveland. For a quarter of a century the little bird had gone unnoticed among the many specimens result-

Continent

By

EDWIN WAY TEALE

All photographs by the author



▸ THE MALE Kirtland's Warbler is a striking bird—lemon-yellow beneath, blue-gray and heavily streaked above. It has a distinctive black mask running back along the side of its face

ing from the Cabot expedition, until Dr. Baird discovered it. His find gave a clue to the wintering ground of the warbler decades before its home and breeding area were known.

So matters stood for upwards of half a century. Single specimens were collected at rare intervals in South Carolina, Ohio, southern Michigan, Missouri, and—in winter—on several islands of the Bahamas. But, during every summer, the warbler disappeared. Ornithologists speculated on its breeding grounds. Some thought it nested in Alaska, others picked Labrador, still others maintained it bred on the tundras of northern Canada. As late as the fall of 1898, Dr. Frank M. Chapman was writing in *The Auk* that he believed the warbler nested in the region of Hudson Bay. "Owing to its rarity and the remoteness of its probable breeding range," he added, "its nest and eggs will doubtless long remain unknown."

That prediction, however, was soon upset. By 1903, nest, eggs, and breeding grounds had all been located. Norman A. Wood, Curator of the ornithological collection at the University of Michigan Museum, in Ann Arbor, had come to the conclusion that the Kirtland's Warbler nested somewhere in the wild areas of northern Michigan. Early in June, 1903, his assistant, E. H. Frothingham, returned from a fishing trip on the Au Sable River with a story of a bird song he had never heard before and a specimen shot by his companion, T. G. Gale. Wood recognized the bird as the Kirtland's Warbler. A few days later, he was riding a Toledo, Ann Arbor, and Northern Railroad train to Roscommon, 35 miles by road from the spot where the song had been heard. This little lumber town, which he reached at four o'clock in the morning, was the nearest point on the railroad to his objective. There he rented a rowboat, and by seven that morning he was floating on the swift current down the south branch of the Au Sable River, starting on a 60-mile rowboat ride that would bring him to a new steel bridge spanning the river west of Mio in Oscoda County. This bridge was the landmark Frothingham had given him.

All day, Wood drifted downstream through wild and interesting country. He listed 40 species of birds before evening. After a night spent at a fishing camp, 35 miles downstream from Roscommon, he started again. On the alert for "sweepers"—cedars toppled into the river through undercutting of the banks – he made rapid progress down the main stream of the river. In open stretches he got out his tackle and caught trout and grayling as he drifted along. By six o'clock, he was hauling his boat ashore near the steel bridge. The date was the first of July.

Seven days of searching followed. Half a dozen Kirtland's Warblers were heard singing, and one male was collected. But the nest eluded him. Then he came to a large tract of several hundred acres that had been burned over six years before and was now covered with young jack pines and a low growth of sweet fern, blueberries, and trailing arbutus. Here Wood came to the end of his quest. Later, he wrote of that moment: "It can be imagined with what delight I beheld the first nest of this rare bird ever seen and with what eagerness I dropped to my knees beside it to make a closer examination of its contents." The nest, about two inches deep and two inches across, held two young birds and a perfect egg. He discovered a second nest over the line in Crawford County. On July 16, a day so cold in Oscoda County that an overcoat was needed, Wood loaded his nests and the material he had collected into a farmer's rig and started on the laborious 35-mile drive over lumber roads to Roscommon. He had solved the long mystery of the summer home and the breeding ground of the Kirtland's Warbler.

The steel bridge that formed Wood's landmark still stands. We drove across it on our first day in Oscoda County. That day we cruised endlessly over the yellow-white sand roads that also form fire lanes. They run, a mile apart, in straight lines that cut the county into a great grid, each block of forest one mile square. Oscoda is still the most sparsely settled county in Michigan. It contains no railroad, no coal yard. Its few scattered communities all originated as lumber camps. Up until the time of World War II, it had no bus line, no doctor, no dentist. We saw deer trails forming straight lines across the sand roads as we drove along, often racked by stretches of washboard ruts and always followed by a moving cloud of dust. With straining ears, we listened for the unfamiliar song of the Kirtland's Warbler. We heard the trill of Pine Warblers, the lisp of Cedar Waxwings, the upscale "zee-zee-zee" of Prairie Warblers, and the curious, drawling, insect-like "buzz—buzz—buzz, buzz, buzz" of Clay-colored Sparrows. But nowhere did we catch anything resembling the song of the bird we were seeking.

We assumed we were missing the

▲ WHEN, in 1903, E. H. Frothingham reported a strange bird in a wild section of Michigan, Norman A. Wood knew the warbler had been located. This bridge was the landmark that led him to its haunts

◄ ONLY FOR ABOUT fifteen years will the Kirtland's Warbler nest in a given section. During that time the trees of a burned-over tract grow from the five-foot minimum to the eighteen-foot maximum song. But, later, Roger Tory Peterson told me he had had a similar experience. He drove all day without hearing the bird; then, after he had heard it and was familiar with the song, he drove back over the same roads. He had not missed the song; the birds just were not there. They nest in scattered colonies, often miles apart. By evening, on that day of frustration, we were pouncing on fragments of familiar bird songs, slamming on the brakes even at unusual squeakings of the car. Completely discouraged, we turned into Hinchman Acres Camp, on the edge of Mio. And there Lady Luck appeared in the form of a small girl with a cowbird fledgling riding on her forefinger.

She came into the office as I was signing for a cabin. The manager explained:

"A lot of people here are interested in birds. We've got two bird doctors in camp, right now. They come up every year in June."

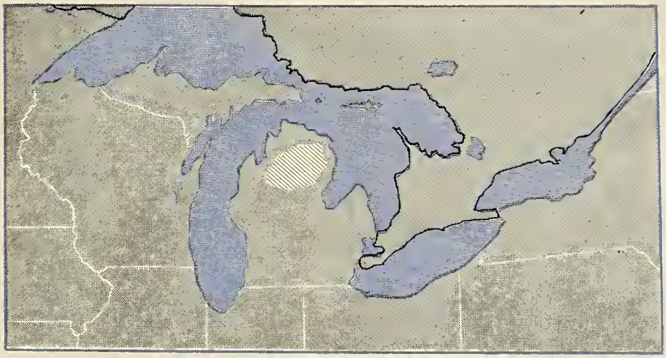
The "bird doctors" proved to be Dr. Josselyn Van Tyne, of the University of Michigan, and Harold Mayfield, a friend of mine from Toledo, Ohio. Dr. Van Tyne, outstanding student of the Kirtland's Warbler, has spent years studying the bird intensively. During ten successive seasons, he has spent at least twenty days in June—from five in the morning until six at night—observing the nesting warblers from a blind. For seven of those ten years, Mayfield has assisted him in the work.

That night, the four of us ate at Kookie's Kitchen, in Mio. Mayfield's work was over for the season, and he was free to show us a warbler's nest in the morning. Van Tyne still had a couple of days' work left, watching birds he had marked with colored bands. Before 4:30 the next morning, while a wood pewee sang its low, soft "twilight song" outside the cabin, we breakfasted with the "bird doctors" on doughnuts and coffee, grapefruit slices and bread, canned pears and orange juice. Thus fortified with vitamins, we started the day.

A new nesting area had been discovered not long before by Verne Dockham, Conservation Officer for the region. It lay among small jack pines, a dozen miles east of Grayling. Three or four pairs of warblers occupied it. Each spring, it is the habit of the returning males to stake out their territories, ranging from a hundred yards to a quarter of a mile across. Immediate chase is given to any small bird that invades the area. The alertness of the males is advertised by their endlessly repeated, far-carrying songs. It is the ear that first detects the presence of a Kirtland's Warbler nesting site.

From mid-May to the last of June—the normal nesting season of the warblers—the song of the male is repeated with almost monotonous regularity. The first thing that surprised us about this song was its shortness. It lasts only about as long as it takes to say "Chattanooga choo-choo"—two seconds or less. The second thing was its loudness. Starting low, it progresses with an ascending "che-che-che," almost like a stammer, suddenly bursting out in a loud, ringing "wee-wee." Once, during the morning, I drove down the road to a slight rise a fifth of a mile away. In spite of the fact that the breeze was blowing in the wrong direction, I could hear perfectly a male singing in the top of a fifteen-foot jack pine.

In fact, when we were close to a singing warbler, the ringing final "wee-wee" was often so loud that it hurt our ears. The song of the Kirtland's Warbler has been described as resembling that of the House Wren and the Northern Water Thrush. It has a bubbling quality. The sound grows louder and faster as it progresses until the final notes come out in a sudden rush. The singing male has the appearance of being in the midst of a kind of spasm. It vibrates, jerks, bobs, seems to jump up and down with the violence of its effort. Its bill is lifted high, its lower mandible moving rapidly as though it were gobbling food. The song of one male seems to stimulate a reply from a neighboring warbler. The males sing when high in trees, low on branches, and even in flight. Several times we



▲ Nowhere outside the small shaded area shown on this map does the Kirtland's Warbler nest. It winters in the Bahamas saw a male arrive at the nest with its bill crammed with small caterpillars. In spite of this impediment to song, it would pause on a branch near the nest, lift its head, and sing as loudly as ever.

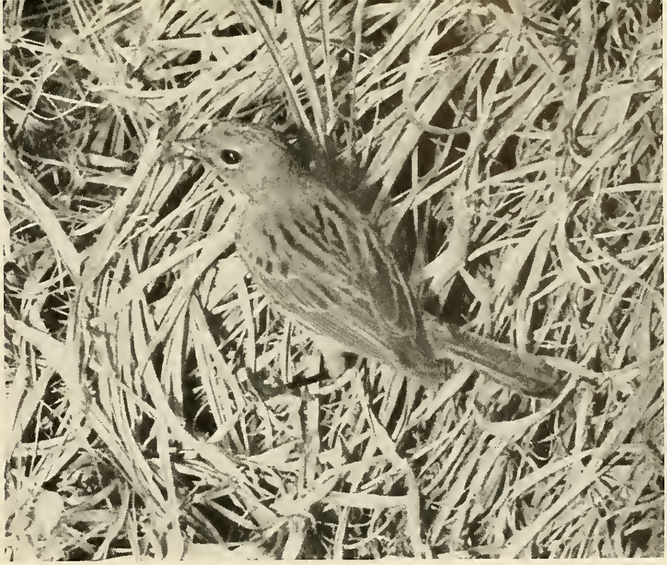
The appearance of the Kirtland's Warbler is as arresting as its song. Conspicuous black streaks mark its bluish-gray back. Its breast is lemon-yellow with bold streakings along the sides and on the flanks. It is a large warbler, measuring five and three-fourths inches from bill to tail. The male has a distinctive black mask running back along the sides of the face. The female, lacking this mask, is clad in duller, grayer plumage. Both birds have the habit of jerking or wagging their tails. Even in silhouette and when the bird is silent, it can be distinguished from the Chipping Sparrow or other small birds by the characteristic jerking of its tail. The only other common warbler in the area that jerks its tail is the Prairie, easily distinguished from the Kirtland's by its reddish-brownish back.

Almost all day long, we sat only fifteen feet or so from the warbler's nest. Both birds were remarkably fearless. After only a short period of uneasiness, they came and went regularly. I set up my camera on a tripod in the open, no more than eight feet from the nest. In less than five minutes, the female was perching on the bellows. Once, when I was standing motionless beside the camera, the male actually dashed between the legs of the tripod in a rush to drive off a trespassing Chipping Sparrow. Individuals vary in shyness, but the Kirtland's Warbler is noted for its lack of fear. The second ornithologist to report a visit to the nesting area in Michigan, Edward Arnold, of Battle Creek, reported in *The Auk*, in 1904, that he found the female warblers so unafraid that they could be caught in the hands on the nest. One male, singing at the top of a jack pine, let me take a position directly under the tree, merely cocking his head to one side to look down at me. Even when I shook the tree, he flew hardly six feet away to the top of an adjoining pine. Unlike most warblers, shy and elusive, appearing and disappearing, the Kirtland's is a dominant personality—one of the outstanding birds of the pine barrens.

The nest, where we spent most of our time that day, was on the ground hidden among blueberries and sweet ferns and dry, wiry grass. The adult birds reached the nest through a kind of tunnel or bower of overarching grass. The nest, itself, was a little cup lined with fine grass, bark, and deer hair. It contained four fledglings in pinfeathers. They had hatched from white eggs speckled with brown. The incubation period for such eggs is about fourteen days. For ten days after hatching, the birds remain in the nest. During the early part of the nesting period, cold snaps are not uncommon. There is a record of frost for every month in the year in Oscoda County and often Van Tyne and Mayfield find their shoes white with rime when walking across the frost-covered pine barrens in early June. Under such conditions, the warblers seem to cease operations. If the nest is half-done, work is stopped; if it is completed, the female delays laying the eggs until warmer weather arrives.

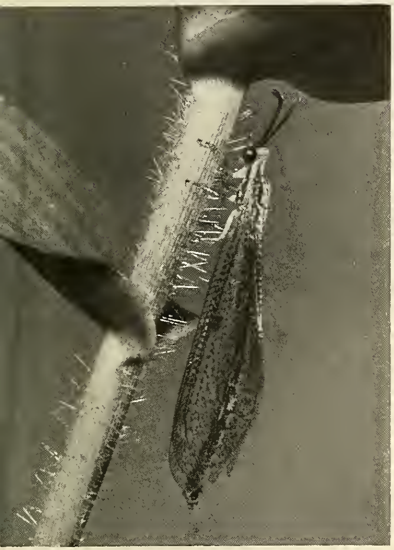
The site of the nest is almost always the same: a little opening surrounded by young pines. Their low branches provide the required steps or perches close to the nest. Almost always the birds we watched

◄ **Fire has killed** this jack pine. If young growth succeeds it, the spot will be acceptable to the Kirtland's Warbler



➤ The female is clad in less brilliant plumage and lacks the mask. These birds are remarkably fearless

An adult ant lion, an insect that forms part the food of the nestling Kirtland's Warbler



hopped from branch to branch in approaching the nest. When the trees grow too large and the branches interlock and shelter the little glades that had been open when the trees were young, the warblers move to new nesting sites. Comparatively few enemies prey on the warblers in the pine barrens. Sharp-shinned hawks sometimes skim down to carry them off, and in a few instances, cowbirds remove the warbler eggs and substitute their own.

In feeding, the warblers appear to comb the lower branches of the pines, usually within three feet of the ground. Small caterpillars, varied with an occasional gauzy-winged adult ant lion, was staple fare on the day we watched the endless procession of meals being brought to the nest. Not infrequently, one of the birds would gobble down a caterpillar hastily, usually the first one encountered after feeding the fledglings. Each time it followed the same procedure. It cocked its head, snapped up the worm, gulped it down, and then wiped both sides of its bill on a twig rapidly as though whetting a knife—jerking and wagging its tail all the while. The tail wagging seems to increase at times when the warbler is excited.

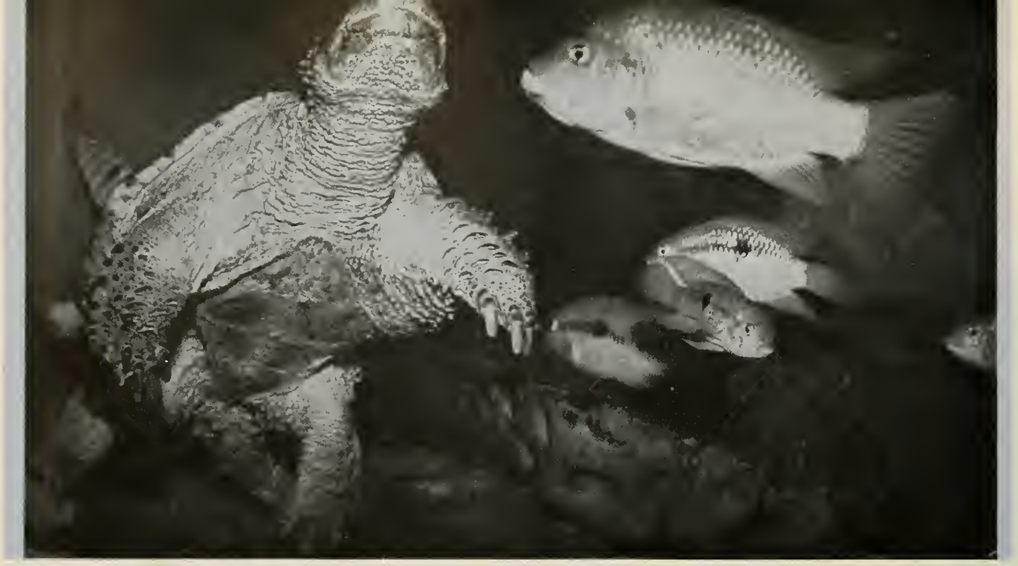
On one occasion, we saw a female flutter like a flycatcher to pick an adult ant lion from the air. Three or four times the male returned with the wings of one of these insects projecting like long moustaches from either side of its bill. Ants are everywhere in Oscoda County's sandy soil. So are the ant lions which, in their immature form, excavate conical pits in which to trap their ant victims.

One curious thing about the feeding habits of the Kirtland's Warbler is the fact that neither Van Tyne nor Mayfield has ever seen one of these birds drink water. Perhaps they obtain moisture from the heavy dews that are characteristic of the region. Or it may be that the larvae they consume provide sufficient fluid for their needs.

On each trip to and from the nest, the birds we observed most closely used the little tunnel of overarching grass. At the end of every visit, as the warbler emerged from this bower of grass, it gave a little fluttering bound, six or eight inches high, as it flew away. This upward bound and flutter was characteristic of the pair we watched.

The Kirtland's Warbler spends only about four months out of the year among the jack pines of its Michigan breeding grounds. The birds return from the south sometime between the tenth and the fifteenth of May. Males and females arrive together. By September, the warblers, old and new, are moving southward on their migration to their wintering grounds on the islands of the Bahamas. Snow comes early in the Michigan pine barrens. The winter is long. During these months, when deer and foxes and snowshoe rabbits are leaving their trails in the drifts, the small band of jack-pine warblers, having traveled south and out over the sea, are living in a land of plentiful food and sunshine.

The next day when, like birds migrating southward out of season, we headed away from the jack pine barrens and their rare warbler inhabitants, we remembered W. H. Hudson's delight on seeing the Dartford Warbler of England, the almost-vanished "furze fairy." Ever afterwards, when anyone mentioned having seen a rare species, Hudson used to say: "But *I* have seen the Dartford Warbler!" We felt the same about this colorful little songbird of the jack pines. *We* had seen the Kirtland's Warbler!



▲ THIS PONDEROUS inhabitant of our muddy ponds and rivers can bite the end off a broomstick, but he cannot dart quickly about in quest of the fish upon which he depends for food. He uses a built-in angling worm in his mouth to lure his prey within grasp

SNAPPERS—Underwater Fishermen

Unlike the small boy who has to dig for worms the day before he goes fishing, the giant alligator snapping turtle is equipped with his own wriggling bait

By WOODY WILLIAMS

Photos by the author, courtesy Steinhart Aquarium, California Academy of Sciences, San Francisco

A PUBLIC AQUARIUM is a different place when the last curious visitor has left. The halls are quiet and the light in the tanks dim. Many of the creatures react to the softened light by settling to the bottom to rest. Their show for the day is over.

There are certain creatures, however, that slyly become busy after dark. Take for example the giant alligator snapping turtle, *Macrochelys temminckii*, at the Steinhart Aquarium in San Francisco. He picks a corner of the tank, or a passageway in a rock, where other inhabitants of the tank are prone to rest, and then he begins to fish.

He opens his ugly jaws wide and remains motionless — except for a curious, wormlike structure in his lower jaw. It is close to his tongue but lighter in color. The two free ends of this organ are rapidly rotated, imitating the squirming movements of a worm or grub. Generally, the turtle sets this apparatus in motion when he is near a fish cornered in the tank bottom, where escape is restricted. His prey seems hypnotized; it remains motionless, as if frozen by fear. The turtle then edges a bit closer and, when within striking distance, lunges at the fish with jaws open. The snap when he claps them shut can be heard through the thick plate glass of the tank. Despite the confined quarters, the victim often escapes, but the scarred sides and torn fins of a number of the fish—large South American cichlids—indicate many narrow escapes. I have actually observed the turtle catch a fish six inches long, hold it between his jaws for a moment, and then gulp it down whole.

Raymond L. Ditmars, the well-known American herpetologist, was the first to report this curious device in the snapper's mouth. His observations, along with other scattered reports, seem to indicate that fish are lured near or into the snapper's mouth in an attempt to catch the "bait," which inside the gaping jaws looks like a worm in a small cave. There is no doubt that in nature the lure is effectively utilized for food capture, for the turtle is normally moss-covered and when motionless looks like nothing more than a submerged rock. In Steinhart's tank, however, fish were never observed actually to swim or dart toward the lure. Of course, constant association with the turtle may have modified their normal reactions. Having been attacked so many times, the fish have probably come to fear the snapper's gaping jaws and bulky body, which are not so well concealed as they would be in a muddy pond in the Mississippi Valley. Thus the turtle can hope to satisfy his appetite only by backing a resting fish into a corner.

In the wild, the snapper's favorite haunts seem to be muddy areas varying in size from ponds to large rivers and bayous. Its range extends from northern Florida northward to Quincy, Illinois; along the Ohio to the Lower Wabash; and westward to San Antonio, Texas. The fossilized remains of this creature have been found in Pleistocene deposits on the Brazos River a short distance above Navasota, Texas.

Throughout its range the snapper's only nonparasitic enemy is man, who sometimes hunts it for food or kills it in the belief that it depletes the supply of waterfowl and game fishes. Its eggs are also occasionally eaten.

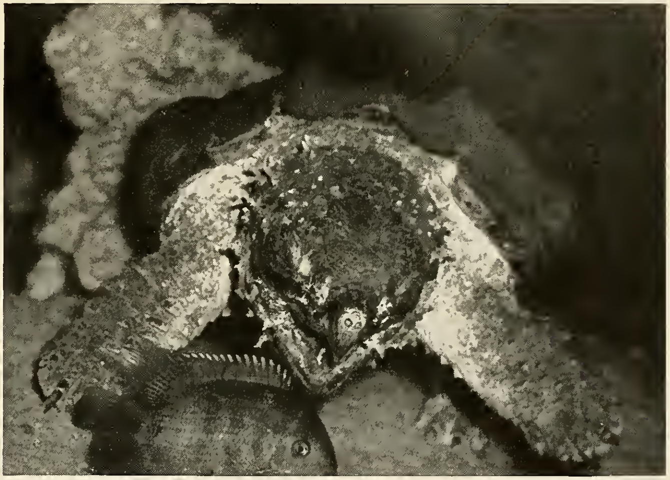
The snapper is the largest freshwater turtle in the United States, attaining a length of over 2 feet and a weight of over 200 pounds. It is famous for its tremendous strength. One specimen was reported by Ditmars to have easily severed three inches off the end of a broomstick, and he had seen snappers cut up fish so neatly that the pieces looked as clean as if sliced by a die. Clifford H. Pope, in his *Turtles of the United States and Canada,* mentions a snapper that carried, without concern, a 165-pound man on its back in Metropolis, Illinois.

Ditmars says that these turtles are shy when in captivity without cover, but the literature also indicates that once a snapper is aroused to anger, it will strike like a snake. Caution should therefore be observed in handling these creatures.

The snapper probably lives for many years. One specimen survived for 42 years in the Brighton Aquarium, and one for 47 years in the Philadelphia Zoological Garden. As the latter specimen was well grown when received, it is believed to have reached well over 50 years of age. The large male shown in the photographs, which is now on exhibit at the Steinhart Aquarium in San Francisco, may readily have reached this age.

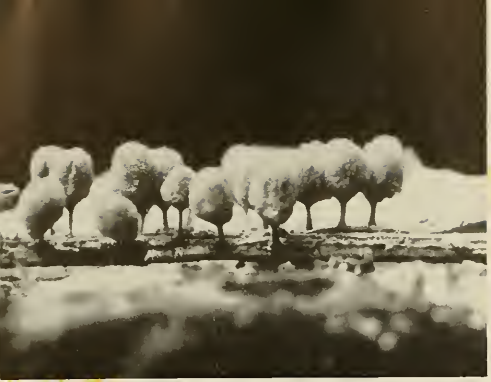
When you observe these ponderous creatures rising to the surface for a gulp of air, or ambushing a fish with their curious lure, it is easy to believe not only that they are well equipped to attain a ripe old age but that they may have snapped their way through quite a chunk of history.

▲ RISING to the surface to breathe: an air-breathing animal that has invaded the underwater world to carry on one of the strangest fishing methods found in nature



▲ THE WHITISH, WORMLIKE ORGAN on the floor of the mouth has two free ends, which rotate rapidly like a squirming worm or grub. The fish remains motionless, as if hypnotized

◄ EDGING CLOSER, the turtle lunges at the fish with jaws wide open. The snap of the powerful jaws can be heard through the thick glass of the tank



▲ Like a forest of miniature trees, *Arcyria denudata* spreads its brick-colored "foliage" 1/16 of an inch above the surface on which it grows

Little Mike

Enter the mysterious realm where plant and animal are almost one, and you will witness one of the most astonishing transformations in Nature

By Hugh Spencer

Photographs by the author

In the middle world that lies between the plant and animal kingdoms there flourish several half-plant, half-animal organisms that bear characteristics of both groups. Most interesting among these are certain fungus-like creatures that are known by the not very prepossessing name of slime molds. In botanical terminology they are called Myxomycetes (pronounced Mix-o-my-SEET-eez).

The motile phase of this organism is called a plasmodium. It has the consistency of thin jelly and moves about freely, creeping through moist spaces in rotting wood or among dead and decaying leaves. It has no fixed form or shape but varies like a thundercloud, putting out feelers that billow out and expand as the rear end is withdrawn and absorbed. Unlike most living things, it has no cellular structure or specialized tissues of any kind. It glides along absorbing food (decaying vegetable matter, living bacteria, and fungal hyphae) from its environment.

Collecting and studying Myxomycetes can be a most entrancing hobby, and, although the number of persons who pursue this avocation is not great, those who have tried it have been amply entertained by the unique character and behavior of their pets.

In the life of a slime mold there are two conspicuous phases—plasmodium and sporangia. After weeks or months, sometimes years, of unfettered existence in moist, dark retreats, the plasmodium seeks a higher, drier location in which to transform from creeping jelly to stationary sporangia. The multinucleate protoplasm changes into one or more complex structures having many characteristics of fungi.

The nature photographer, in pursuit of new material for his negative files, may spend many hours in the field and return empty-handed and weary at the end of the day. Then, in his own dooryard, or while sitting quietly in his studio in the evening, something he has long sought in vain turns up right at hand. Such was the case with Little Mike.

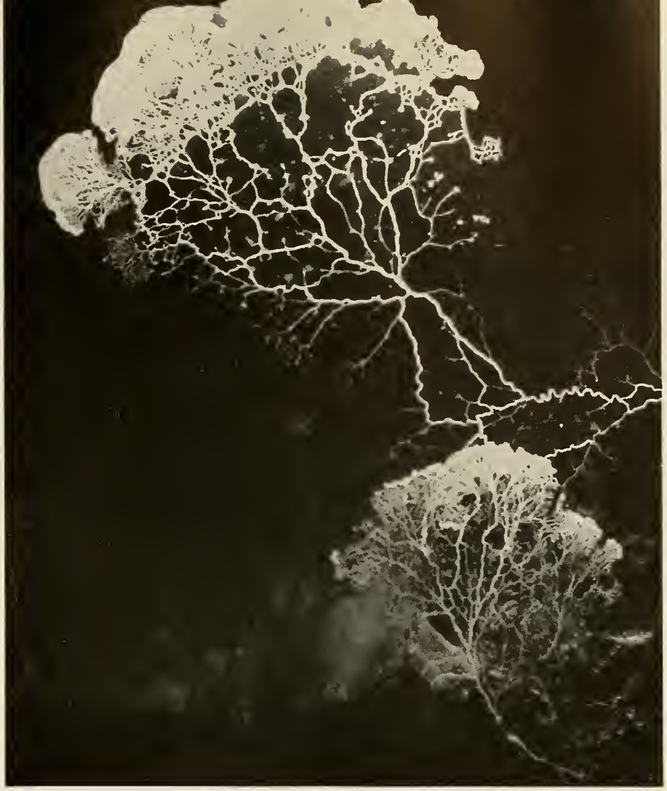
A tobacco jar on my worktable, which had previously served as a terrarium for some small frogs, was the scene of my first encounter with the motile Myxomycete. Sphagnum moss and some dead leaves filled the bottom of the jar. One evening out of this material, slowly pulsing up the side of the glass, arose the fanlike network of Little Mike's advancing plasmodium. Fascinated, I watched while the pattern moved and changed like cumulus clouds rolling up the sky on a summer afternoon. Slime mold! What an utterly shameful and inappropriate name for one of Nature's most amazing and beautiful forms of life.

Older zoological literature places the Myxomycetes among the Protozoa and thus in the *animal* kingdom. Some have called them Mycetozoa, or "fungus animals." But leading modern authorities regard them as fungi, which are part of the *plant* world. Thus our mystery organism, along with several groups of flagellates, enjoy the curious distinction of having been placed in both of the primary divisions of life.

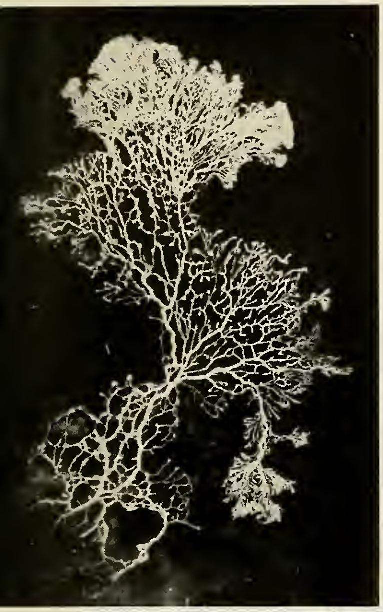
Fusing, or confusing, Myxo with Myceto, we came up with "Mike," and consequently Little Mike is the nickname by which the specimen in the tobacco jar will henceforth be designated.

Little Mike was a translucent, milky-white tracery, with the leading portion forming a fan of radiating veins. These veins, flattened against the glass to the size of a quarter-dollar, were trailed by a mesh of lesser veins. Below this a second mass of smaller size pushed up out of the muck. The rate of progression was about a quarter of an inch an hour. On several successive evenings I watched Little Mike advance and retreat, expand and contract, exploring the surface of the jar and, apparently, always striving for some higher, better life than that in the wet soil.

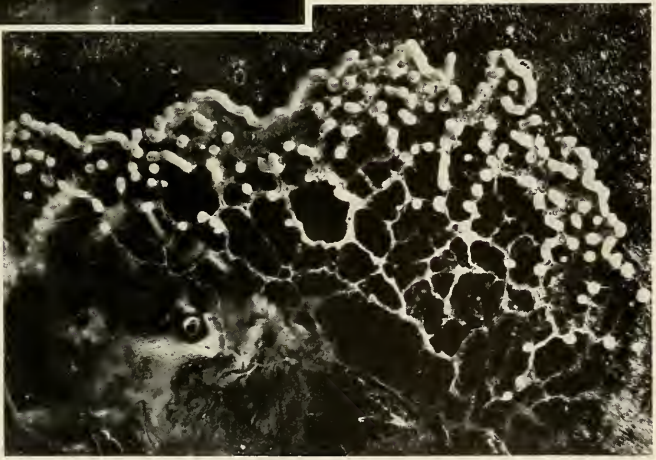
Animated protoplasm without nerves, without brain, without muscles, heart, or respiratory organs, yet capable of controlled and seemingly purposeful movement, of response to light, heat, and moisture —surely such a thing is worth anyone's attention. Think of it: a thing able to select digestable material; fluid enough so that a specimen has been known to pass through a mass of wet cotton wool and re-form on the other side, yet firm enough to retain character and unity under normal conditions; and, further, an organism able to change its structure into the diversified tissues of reproductive sporangia.



⮝ CAPABLE of controlled and seemingly purposeful motion and of response to light, heat, and moisture, the jelly-like plasmodium surges forward at the rate of an inch every three or four hours. A specimen has been known to pass through a mass of wet cotton and re-form on the other side

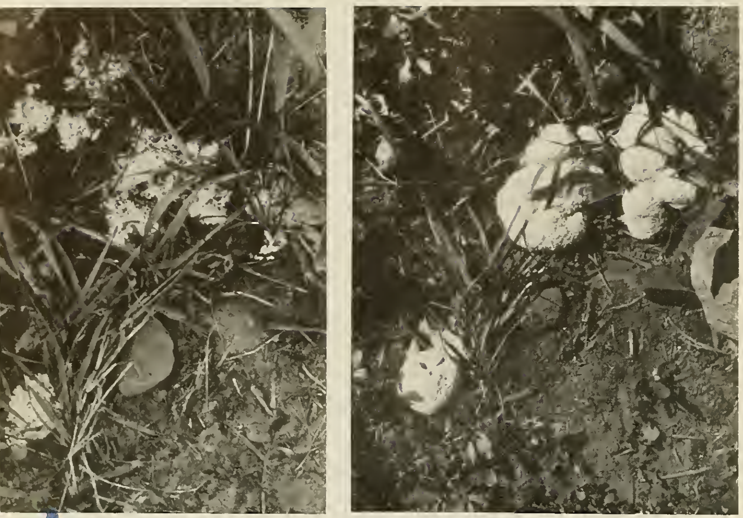


OVERNIGHT the simple but animate plasmodium (*left*) became a cluster of inanimate but complex sporangia with plantlike characteristics (*below*)



Fructification is the ultimate goal of all slime molds, as it is of higher plants and animals. So far, our creature has behaved like an animal: it moved like an animal, its feeding habits were animal-like, and its behavior was like that of a giant amoeba. I did not witness the transition of Little Mike from motile plasmodium to stationary sporangia, as that event took place during the hours of night or early morning. Overnight the creeping fungus had reached the top of the jar and had broken up into a multitude of minute, spherical sporangia, smaller than pinheads and tangled in a stain of dried and hardened tissue. All that remained of Little Mike was now a cluster of structures bearing no resemblance to the original organism. Without seeing the metamorphosis, or at least having previous knowledge of the behavior, one would have difficulty recognizing these motionless bodies as the alter ego of the erstwhile roving plasmodium. The process by which this rudimentary film of protoplasm becomes a complex structure of differentiated tissues is one of the most astonishing phenomena of nature.

The sporangia of different species

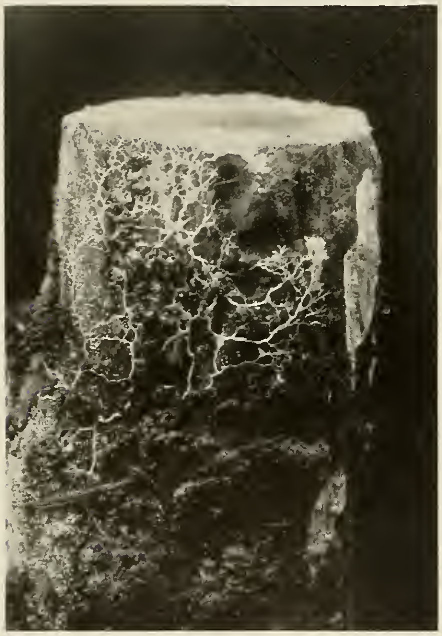


▲ CHANGE IN TWELVE HOURS. On a July evening, this slime mold was found spreading over the ground near a compost heap in the garden. The following morning these biscuit-shaped masses had appeared, flattened against the ground. The largest were about four inches across

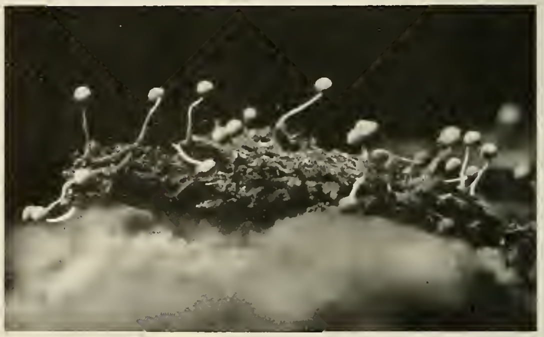
vary greatly in size, shape, and color. Little Mike was a *Physarum* with minute globular sporangia. *Stemonitis* produces clusters of slender plumes less than a quarter of an inch in length. Under a magnifying glass a group of *Arcyria denudata* looks like a forest of miniature trees with brick-red foliage. The largest species is *Fuligo,* which produces sporangia as large as a man's hand and about an inch thick. Although these sporangia differ greatly in appearance, their function is the same in every instance. All of them produce minute spores, which are easily scattered by the wind and will germinate readily wherever they find suitable moist conditions.

The ensuing stages between spore and plasmodium can be observed only with the aid of a microscope. The naked, amoeboid protoplast that escapes from the spore

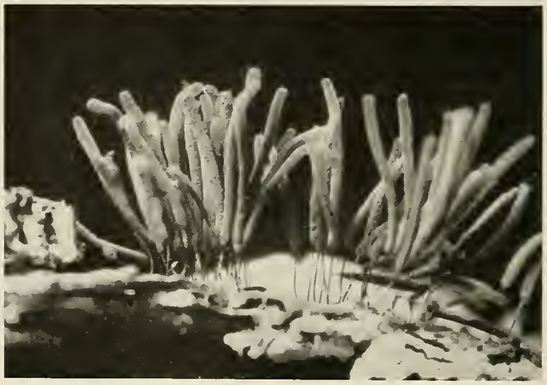
Continued on page 190



▲ A YELLOW PLASMODIUM on an old stump. The extended rays and branches would aggregate many feet in length



▲ THE TINY GLOBULAR SPORANGIA of *Physarum* on their slender stalks



➤ DAINTY PLUMES of *Stemonitis,* commonly found near oak trees. These Lilliputian "cat-tails" stand about 3/16 of an inch in height

Photo by U. S. Forest Service

▲ EVERGREEN FORESTS and myriads of lakes characterize the Quetico-Superior wilderness

CONSERVATION Victories

By RICHARD H. POUGH

Chairman, Department of Conservation
American Museum of Natural History

IN a field in which defeats have all too often been the order of the day in recent years, it is heartening to have two great conservation victories to report.

Under the terms of a recently issued history-making executive order, an air-space reservation has been established over the million-acre Quetico-Superior wilderness area of northern Minnesota. On January 1, 1952, all flights into the area or over it at less than 2000 feet must cease. This should put an end to the resorts that were beginning to grow up deep inside the roadless area and were so out of keeping with its whole character. It should also expedite the task of buying out the few privately owned tracts that still lie scattered through the publicly held national forest land.

This air closure removes one more obstacle to the final creation of a great international peace memorial forest on both sides of the United States-Canadian border. It will be a forest open to all who seek solitude and are willing to find it via the canoe or on foot. The final establishment of such an area will make certain the preservation for all time of at least one area in the United States remote and wild enough for the survival of a small nucleus of timber wolves, which disappear everywhere as civilization moves in. Here there will be no reason to

Ewing Galloway photo

◄ SNAKE RIVER and the Teton Mountain Range challenge nature's law that the race belongs to the swift and that the plant eater lives but to feed the meat eater.

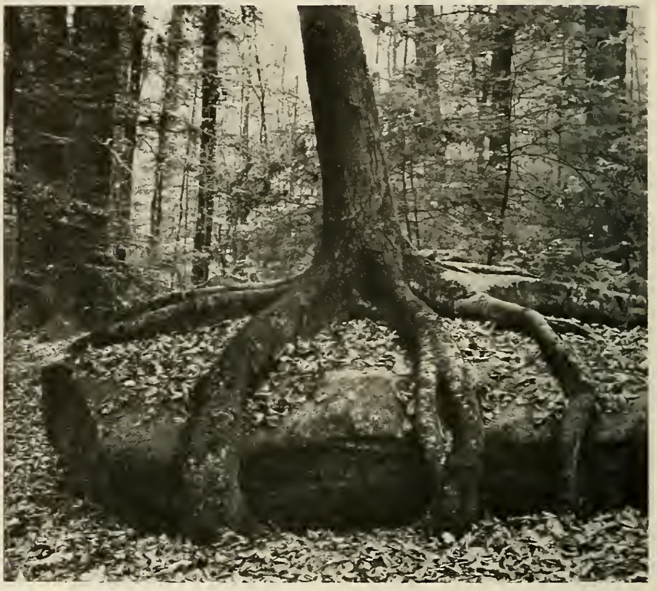
With the deeding of some 300,000 acres of land in Jackson Hole to the National Park Service by the Rockefeller interests, the long-drawn-out controversy over the Jackson Hole National Monument comes to a virtual close, and the preservation of the primitive character of this glorious valley is assured. A few problems remain to be solved, but they can now be worked out on a calm basis of fact instead of in the heat of political battle. The most important problem concerns the elk population that summers in Yellowstone Park and the adjacent national parks. Blocked now for many years from access to their ancestral wintering grounds in the Red Desert, these elk must be prevented from increasing to levels that can only result in wholesale starvation and devastating damage to the limited wintering range still available. In the absence of predators, this means that there must be sufficient sport hunting or annual butchering by park rangers to hold the population at the level where it can be supported in vigorous health and where it will not overbrowse and destroy its food supply.

For the first victory, every American conservationist who did not leave it to the other fellow but made his own voice felt can take credit. This is in part true also in the second case; but let us not forget that there would have been little to battle for if a public-spirited American family — the Rockefellers — had not been willing to provide nearly one and a half million dollars to purchase the critically important Snake River bottomlands that years ago had been allowed to pass into private hands.

Unfortunately, many another conservation project having equally great public support—such as the attempt to save as a national park or wildlife refuge the last small section of undeveloped beach on the coast of New Jersey—languishes for lack of more Americans as public-spirited as the Rockefellers.

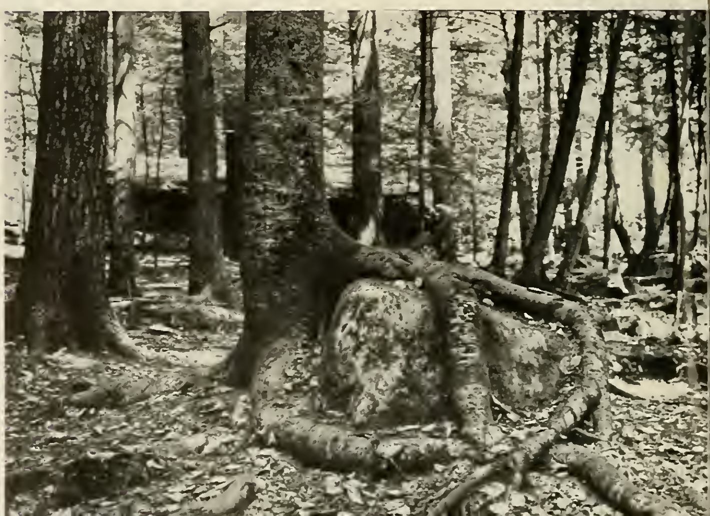
Woodland

How startling—and sometimes baffling—are the ways in which



"My woodland throne,
I must confess.
Was won by means
You may not guess."

A branchlike root
Above the ground—
Did the rock rise up
Or the tree slip down?



Wonders

oung tree grows with all odds against it!

By William M. Harlow
New York State College of Forestry

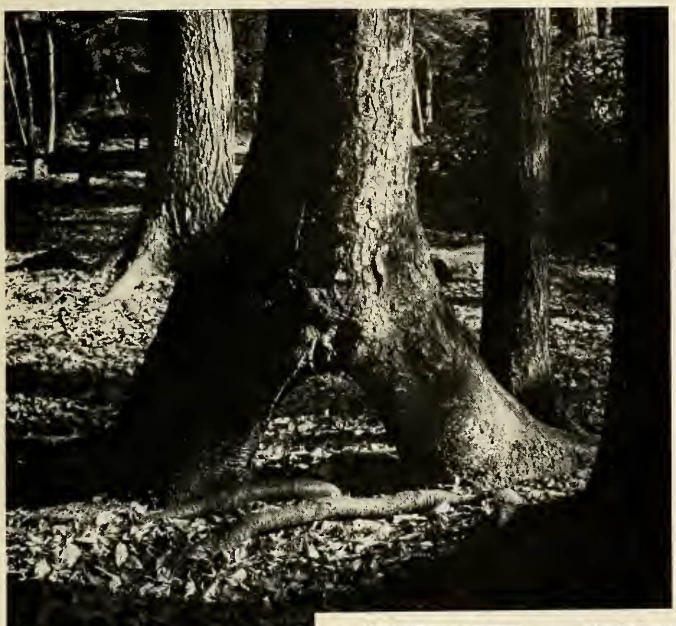
Photographs by
Helen Faye

ONE of the most interesting things to observe in the woods is the manner in which a young seedling tree makes the best of a seemingly hopeless or at least difficult situation and manages somehow to live and grow and even to prosper. In these days of Existentialism and other hopeless philosophies, it does one good to walk along a woodland trail and to see trees like the ones pictured on this page. They were all photographed in Cook Forest Park, Pennsylvania.

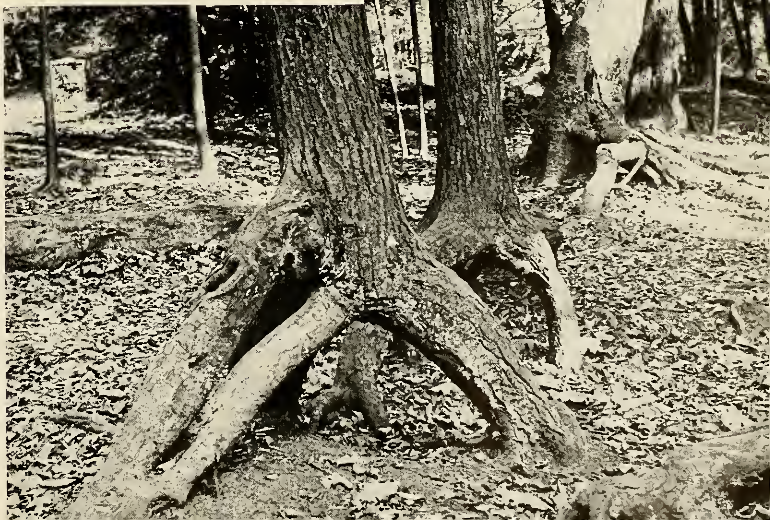
The first photograph shows a fairly common situation in which such trees as black birch, yellow birch, and hemlock manage to extend their roots along the surface of a rock upon which the seed fell, and eventually to reach the ground below.

The tree shown at lower left is not so easily explained. There seem to be two possible answers. The first is that it started on top of a small stump which was close to the rock; the stump finally rotted away, but not until a root had grown laterally over to the boulder. The other possibility is that the young tree grew in some moss at the edge of the rock and slowly shifted to its present position. However, it is quite possible that neither of these suggestions furnishes the correct explanation!

The trees in the two other photographs very evidently began life on an old, perhaps rotting log which has long since disappeared.



"From front and rear
I ape a dancer,
But why I'm arched
Is yours to answer."



Did these roots
Deny their birth
By springing upward
From the earth?

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DEATH OF A SCIENCE IN RUSSIA

- - - - - Edited by Conway Zirkle

University of Pennsylvania Press
$3.75, 319 pp.

THIS account of the perversion of the science of heredity in the Soviet Union is one of the most terrifying books ever written. Bombs kill only bodies. The killing of knowledge and of free enquiry is a far surer way to stop human progress and to enslave mankind. Ten or fifteen years ago it seemed incredible that such things could happen in a civilized country and in one that had, regardless of possible other faults, tended to value and to support true scientific research. Here is the damning record of intellectual murder and a display of the means employed, both subtle and brutal.

Apologists have represented the outcome as a result of open and democratic scientific discussion, and anti-communists have cited it as a simple example of police-state methods and dictatorial thought control. The detailed evidence shows that neither view adequately represents the process or the danger. A parody of scientific discussion was used to suppress rather than to seek the truth, the exact opposite of the procedure travestied. This was only one of the many methods used in a long struggle. The struggle was already lost before it reached the last stage of overt political control and open reprisals against those who failed to run to cover or to recant, publicly shaming the values for which they had lived.

Dr. Zirkle has supplied such background as is necessary for the nongeneticist to appreciate the issues and to follow the sequence of events. The bulk of his book consists of authoritative documents, mainly reports from *Pravda* plus some other statements by informed persons, such as the eminent geneticist Muller, who had realistically approved earlier Soviet accomplishments in science. The evidence is plain. The implications are so extensive, even outside the field of science, and so menacing to freedom of thought and of institutions that this book should be required reading for anyone honestly interested in human welfare.

The only serious editorial imperfection is the lack of a list of *dramatis personae* or an index.

G. G. Simpson

AN INTRODUCTION TO BIRDS

- - - - - - - - - - by John Kieran

Garden City Pub. Co.
$2.00, 77 pp., 99 illusts.

TO ONE who married the American Ornithologists Union 38 years ago, John Kieran's *An Introduction to Birds* comes as a blessing 39 years overdue.

The amateur is too often plunged into ornithology before having any chance to learn the abc's of birds themselves. The professional ornithologist is so far along in the disease that he rarely clicks with the beginner. The former knows so much that the layman regards him with awe. Writers try to emulate him, tucking in scientific names and descriptions.

Along comes everybody's John Kieran, with his courage and his humor, without self-consciousness among his ornithological pals. He tells, in clear language and with scholarly simplicity, how to know the birds.

"The first rule to follow if you want to know the birds is: Look at them!" says Mr. Kieran. One can add a second rule: Get Kieran's book.

There are 99 colored portraits of our whole country's common birds, with their approximate lengths in inches below their common names. Clear descriptions tell in what kind of setting each bird may be found—whether woods, fields, seashore, gardens. Songs are beautifully described, with particular appreciation for that of the hermit thrush: "lovely, liquid, dreamy, ethereal."

Kieran's style matches the charm of the birds he is sharing:

"The simple facts about Hummingbirds are like the birds themselves, almost unbelievable," and, "The flashing Tree Swallow that sweeps in chattering flight over our summer meadows. . . ." On every page there are such phrases. Poetry and accuracy are not always twins, but Mr. Kieran is a trained observer with knowledge of his subject as background for his sensitive appreciation and his gift for its expression.

The reproductions in color of Don Eckelberry's paintings are beautifully done. The book is both distinguished and delightful to own or to give away. The price is also delightful in these days of high-priced books.

Grace E. Barstow Murphy

PREHISTORIC SOUTHWESTERNERS FROM BASKETMAKER TO PUEBLO

- - - - by Charles Avery Amsden

Southwest Museum, Los Angeles
Paper—$3.50, cloth—$4.25
163 pp., 2 maps, 39 plates, 46 figs.

THE core of this publication is a comprehensive account of a once widely ranging, partly semisedentary people whose relics, dating from the first five or six centuries of our era, have been especially well preserved in the arid "Four Corner" region of the Southwest. They were called Basketmakers by their earliest discoverers in Utah, about 1890, simply to distinguish them from their Pueblo Indian neighbors who were expert potters. Their collected remains, both cultural and somatic, held a place of special importance for all regional archaeologists until traces of the much earlier and even more widely disseminated Folsom culture came to light in 1927. This temporarily dampened interest in the Basketmakers who, however, still retain the unique position of affording us our best American evidences of the gradual transition from the hunting to the agricultural mode of life.

Our author prefaces his subject with a prologue on the first peopling of America. He next devotes a chapter to a brief but glowing description of the Southwest, to its partial conquest and colonization, from 1540 onward, by the Spaniards, and

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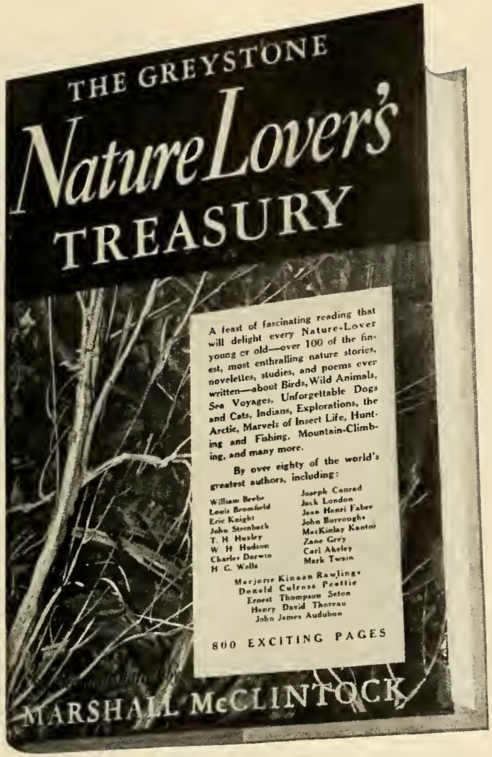

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to its more and more systematic archaeological investigation, mostly by Americans, from 1846 to the present day. Another chapter is added giving an intelligible explanation of the supplementary study of local tree rings which, applied to the timbers of both the inhabited and the long-abandoned Indian dwellings, has resulted in an absolute chronology for the region.

Six chapters of this book are devoted to detailed description and illustration of the principal traits of Basketmaker culture. These exhibit marked skill and taste in the manipulation of stone, shell, bone, wood, hide, hair, and clay, resulting in about 200 specific types of contrivances, answering to various requirements of the maker's activities. Among the features treated are dwellings and storage caches, articles of dress, personal adornments, ceremonial objects, human and animal paintings on suitable rock exposures, tools, weapons, household utensils, hunting gear; cultivated maize, squashes, and beans; domesticated dog and turkey; and, finally, the ceremonial disposal of the dead. This abbreviated inventory of more or less diagnostic traits did not, of course, originate all at once but was the result of improvements and additions ranging over more than half a millennium. The "improvements" may be ascribed to native ingenuity, but the "additions" were doubtless for the most part borrowed from neighboring tribes. This borrowing appears to have proved fatal, for in the end the culture lost its identity. The Basketmakers became Pueblos.

Mr. Amsden, now passed away, may not have left his aptly phrased and often illuminating treatment in its intended final form, but his colleagues and friends have checked it and supplied helpful and attractive illustrations, as well as a useful bibliography, and Dr. A. V. Kidder has added an appreciative Introduction.

N. C. Nelson

FREDERICK CATHERWOOD, Archt

- by Victor Wolfgang von Hagen
Introduction by Aldous Huxley

Oxford University Press, $5.00
177 pp., 38 plates

IN the author's words, this biography of the nineteenth century architect, artist, and pioneer archaeologist is "an attempt to raise Frederick Catherwood out of the alluvium of the 'Stream of Time,' to cover him with flesh, and give him life." If one judges the book narrowly, and merely as an attempt to recreate a personality, Mr. von Hagen's effort does not quite succeed, but through

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no fault of his own. So completely has Catherwood been obliterated by time that no such recreation will ever be possible. Although he was an intimate of Keats, Shelley, Severn, Prescott, and Stephens, no journalist recorded his exploits and no artist painted his likeness. Indeed, the author was obliged to construct Catherwood's bare life history from bits and pieces drawn from Copenhagen, Cairo, London, and British Guiana.

Yet even the bald facts of Catherwood's incredible life are absorbing and worthy of record. Although he is justly famous for his magnificent drawings of the Maya ruins of Mexico and Central America, few are aware that Catherwood had also made firsthand studies of the ancient monuments of Italy, Greece, and the Near East. In addition, he was a pioneer Egyptologist of outstanding importance. If not actually the rediscoverer of Maya civilization, Catherwood and his colleague, John Lloyd Stephens, established its existence beyond all doubt and brought it to the attention of both scholars and the public. Between trips of archaeological exploration, Catherwood managed to practice his profession as architect in New York and elsewhere, to build the first railway on the South American continent (in British Guiana), and to participate in the California gold rush of 1849.

Mr. von Hagen has himself undertaken an "archaeological investigation" in assembling the facts of Catherwood's career from diverse and inaccessible sources. The book is a handsome contribution, and the numerous reproductions of Catherwood's drawings, and of lithographs and engravings based on them, are uniformly excellent.

HARRY TSCHOPIK, JR.

AUDUBON'S BIRDS OF AMERICA

- - - - Introduction and captions by Ludlow Griscom

The Macmillan Co., $2.95
320 pp., 288 colored plates

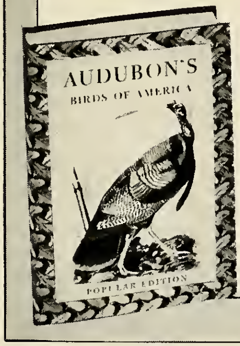
APPARENTLY encouraged by the success of their earlier royal octavo edition of Audubon's paintings of the birds of America, Macmillan has brought out this "popular edition." It contains some 288 of Audubon's plates, each reduced to a size of about four by five inches. The color reproduction in this volume, it must be admitted at once, is about the worst imaginable. Plain black and white would have been better. The blues are particularly obnoxious, and all sorts of birds—fox sparrows, mockingbirds, Connecticut warblers—are tinted with bright blue! The other colors are usually too dull; the flaming crest of the ivory-billed woodpecker,

AUDUBON'S

Birds of America

POPULAR EDITION

The best of Audubon's famous bird paintings—288 full-page, 4-color plates—are now available in this new, handy-sized book. Its contents, its size, and its price make it the perfect bird book for everybody.



LUDLOW GRISCOM, Chairman of the Board of the National Audubon Society, has written a splendid, new Introduction, as well as the concise descriptive text accompanying each of the 288 magnificent plates.

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"A model of archaeological research. At the tip of his pen takes shape . . . an overlooked key figure in the archaeology of the Americas."

—JOTHAM JOHNSON,
N. Y. Times Book Review

Frederick
Catherwood
Arch^t
By
VICTOR WOLFGANG
VON HAGEN

Introduction by Aldous Huxley

- Here, reconstructed from all the known original material, is the amazing life-story of the archaeologist-explorer and student of natural history whose discoveries in Mayan culture and superb lithographs of Central American antiquities alone entitle him to lasting fame.
- Catherwood was a friend of the great scientists of his day in Europe and America. He was an authority on the civilizations of Egypt, Greece and Arabia. His exciting, checkered career has been re-created by an author who is himself an archaeologist, explorer and authority on natural history.
- Besides its adventurous and revealing story the book also reproduces, for the first time since its original publication, the complete series of Catherwood's great lithographs "Views of Ancient Monuments."
- "A most surprising story and very delightful to read . . . The reproductions of his beautiful drawings are exceptionally fine." — VAN WYCK BROOKS

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* * *

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for example, is here a sickly brown. Of course, among 288 plates one finds some that are passable.

Ludlow Griscom has written a brief caption for each plate, giving the range, habitat, and status of the bird depicted. Since this information is available in so many other books, would it not have been better to quote a sentence or two from Audubon's own vivid "ornithological biographies"? In his general introduction Griscom makes it clear that the exaggerated and even grotesque attitudes of many of Audubon's birds were a symbol of his revolt against the stylized and unfeeling methods of portraying nature then in vogue.

This volume appeared shortly after two others in which a much smaller number of Audubon's paintings are much better reproduced. Comparison leaves no doubt that in things of this sort, quality is preferable to quantity.

Dean Amadon

THE INVASION OF NEW ZEALAND BY PEOPLE, PLANTS AND ANIMALS: THE SOUTH ISLAND

- - - - - - by Andrew Hill Clark

Rutgers University Press, $6.00
465 pp., 81 illusts.

HERE is an admirable and detailed account of the relation between man and environment in the world's most isolated and most rapidly made-over land. New Zealand is the newest abode of human beings, whether we refer to the Polynesian aborigines who first arrived about a thousand years ago or to Europeans who began to settle close to the opening of the nineteenth century. The earliest comers were exploiters in search of whale oil, fur-seal skins, native "flax," and timber.

Immigrants seeking permanent homes arrived in the South Island mostly after 1840. They represented, in large part, deliberately organized efforts to transfer a cross section of British society, with all the contemporary mores, to the antipodean outpost of the Empire. Professor Clark, who has had critical experience in the field, shows clearly how developments in land use have departed widely from the plans of the founders. More and more, the inhabitants have come to depend upon their own experience and initiative in devising the pastoral and agricultural practices upon which their economy depends. Despite the British heritage and the nostalgic introduction of countless plants and animals from "home," the very landscape in the densely occupied parts of the island now smacks more of California than of Britain. The universal shelter belts and clumps of Monterey cypresses and Monterey pines—far more majestic than in their own hearthland—are a case in point.

This book deals, in terms as precise and quantitative as the data warrant, with the struggles, the successes, and the mistakes involved in the creation of a new, prevailingly rural culture. The "invasion" has had many tragic corollaries, because scores of alien organisms have become devastating, almost hopeless, pests. Coupled with reckless overuse of natural resources, they have led to land deterioration that is a challenge to the outstanding scientific competence and the finally aroused popular sentiment of the Dominion.

R. C. M.

LITTLE MIKE

Continued from page 182

shell shows distinctly animal characteristics. It has a long tail, or flagellum, by means of which it may swim freely, or it may creep like an amoeba. These tiny protoplasts multiply rapidly by division, forming a multitude of "swarm cells." After a time, these cells unite in pairs to produce miniature plasmodia similar to the larger one already described. From time to time, as they meet others of their kind, they continue to unite, forming larger and larger units; or the single "miniature plasmodium" may develop by itself until the full-grown organism is produced.

The slime molds are of little economic importance, though one species is parasitic on cabbage roots and causes some loss to crops of this vegetable. They are interesting

VENUS'S FLYTRAP

This carnivorous plant found only in S. E. North Carolina, now available as colorful novelty for home or as botanical specimen. May through July. Each plant shipped postpaid in own soil with simple instructions. Each $1.00. Six $5.00.

WILL REHDER, *Florist,* Wilmington, N.C.

chiefly as biological curiosities, as a sort of Dr. Jekyll and Mr. Hyde in Nature's underworld and, of course, for the attractive patterns formed by the plasmodia and the beauty and variety of the fruiting stages.

With the exception of *Fuligo,* the sporangia of Myxomycetes are so small that they easily escape the notice of all but the most observing persons. Would-be collectors should bear in mind that a single sporangium of *Arcyria, Physarum,* and many others is no larger than a capital letter in the type on this page, and that a plume of *Stemonitis* could easily be passed through a small "o." With this in mind, and after a study of the photographs accompanying this article, look for specimens attached to leaves, bits of bark and dead wood under old trees, or on rotting logs in the forest. The best time to find them is a day or two after a warm summer rain.

Plasmodia are rarely seen in the open. Slime mold enthusiasts usually obtain specimens by gathering bits of decaying wood, dead leaves, and forest litter. These are placed in covered glass vessels and kept moist and warm. Temperatures of 67 to 72 degrees F. are considered best. White blotting paper or pieces of paper towel may be placed under the material to facilitate observation. Then follows a period of watchful waiting, and hoping. Sooner or later a plasmodium may appear, spreading thin feelers out on the paper or onto the glass. It may be white, like Little Mike, or it may be yellow, green, tan, brown, orange, or even black. Whatever color, it brings elation to the slime-mold fan.

Plasmodia, as pets, require little in the way of care or attention. The principal requisite is moisture. Some collectors supplement the supply of natural food by sprinkling a small quantity of oatmeal flour into the enclosure once or twice a week. Under certain conditions, plasmodia may attain a ripe old age before changing to sporangia. One collector has a record of a specimen in captivity for nine years! A Myxomycetoid zoo can be fun.

LETTERS

THE MAN WHO READS IT

Continued from page 155

and are interested only in telling the truth, no matter how amazing it may be. There are delightful drawings and wonderful photographs that aid greatly in the reader's enjoyment and understanding of the text. In the course of time, a regular reader of NATURAL HISTORY Magazine is bound to obtain a liberal education in the natural sciences with no feeling of pain. It widens our horizon and adds much to our enjoyment of life to know these things. Knowledge of one thing in Nature leads to another, and the effect is cumulative; the more we learn, the greater becomes the desire to carry further our knowledge of Nature, the world in which we live, and the Universe around us. Walled in as we are now by great cities, monstrous housing projects, specialized careers, and man-made gadgets and contraptions, more than ever we need to realize our true place in the sun and our proper relation to the stars in their courses.

Of all men, I think the naturalist is the one who can roam the farthest, get most out of life, meet friends wherever he goes, and, in the words of Thoreau, let the night find him everywhere at home.

LETTERS

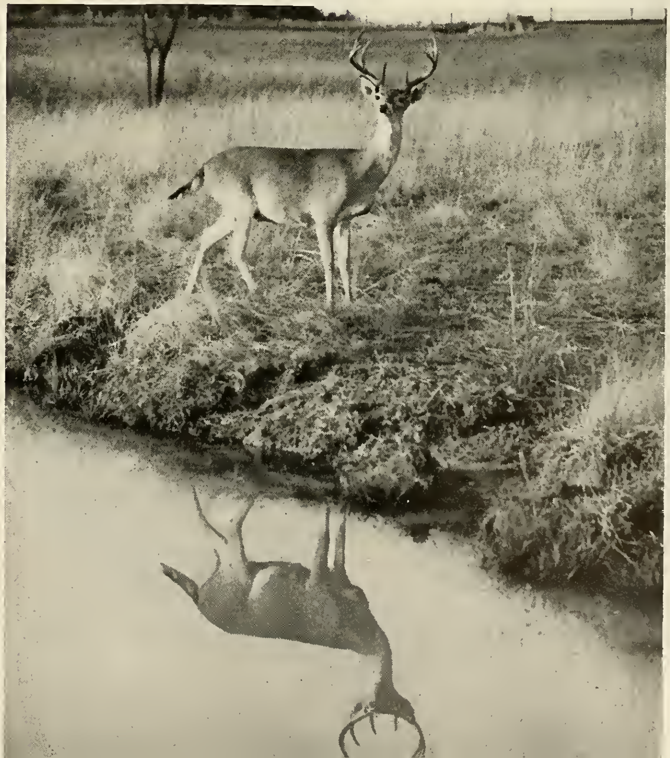
Stag at Eve

SIRS:

This photograph, which was taken near here in the late afternoon, reminds me of the first line of Scott's "Lady of the Lake": "The stag at eve had drunk his fill." So that is what I call it, and I hope readers of NATURAL HISTORY will like it.

MRS. THASE DANIEL.

Norphlet, Ark.



It's a Nutcracker

SIRS:

On page 98 of your March issue is a photograph of a bird that is identified as a Canada Jay in the letter accompanying it. It looks more like a Clark's Nutcracker to me, judging from the white patch in the wing and the lack of a black nape, though it *might* be an immature bird. The bill also looks as if it could not be that of a jay. Could you inform me regarding the picture? Incidentally, it is a fine photograph, regardless of the species, and yours is a fine magazine. I congratulate you on it.

Peter W. Castle.

Putney, Vt.

Mr. Castle is absolutely right, and we are serving a sentence of six months at hard nutcracking. —Ed.

Sirs:

Natural History Magazine seems to grow more interesting each year. The article on the New Zealand Kiwi was read at our Stamp Club meeting the evening that our topic was "Birds on Stamps," and everyone found it interesting and amusing. My copy of the Magazine eventually goes to the local TB Sanatorium, where it is read to pieces, from all accounts. Everyone exclaims over the beautiful covers.

Ida M. Luther.

Norwich, Conn.

Sirs:

Among the innumerable letters that you receive, will you accept a modest tribute from me. I have under my eyes the whole collection of Natural History for 1949, and I must say that it is a veritable enchantment. With its harmony of colors and its scientific text, Natural History Magazine is a pure marvel which, in this painful era, puts a charming bit of poetry into our otherwise disillusioned hearts.

Alphones O. Renaud,
Trumpeter in Jazz,
Composer of Music

Bordeaux, France

Sirs:

Just received our copy of Natural History Magazine for March, 1950. It is one of the finest issues I have ever seen, and I have all the copies since 1922. Every article in this month's issue has a very special appeal to me . . .

I am enclosing my check in the amount of fifty cents for which kindly send me another copy of this issue of Natural History.

You are to be congratulated for issuing such a wonderful magazine. Long may it be published under your editorship.

E. B. Powers.

San Diego, Calif.

Sirs:

One or more red-tailed hawks could recently be seen spread-eagled on fences in three different but adjacent counties in California. In each case, the farmer retorted "chick hawk." So here are three startling examples of biological illiteracy, as will be seen by the last four words below.

In one of the above counties the writer had a bottomland ranch. Some 40 years ago, neighborhood farmers held a "hawk-and-owl shoot." They very systematically cleaned out both birds over a considerable area. Next year, the very prolific ground squirrels, being free from predator interference, raised numerous young.

That winter came one of a lifetime's copious floods. The levee, during the summer, had been honeycombed with squirrel burrows. It crevassed under flood pressure, and sand was deposited over much of the writer's land. It was quartz sand from the tailings of gold mines upcountry. The ranch thus became a partial desert. Quartz sand does not rot, so soil-making proceeds painfully slowly. Now, after 40 years, we are starting to harvest the first beginnings of crops.

California scientists made a study of this hawk's food habits and analyzed 2,094 ejected food pellets. These showed 1,049 ground squirrels, 794 gophers, 322 rabbits, 14 jays, 70 rattlesnakes, 776 other reptiles. "NO POULTRY WAS FOUND."

C. M. Goethe.

Sacramento, Calif.

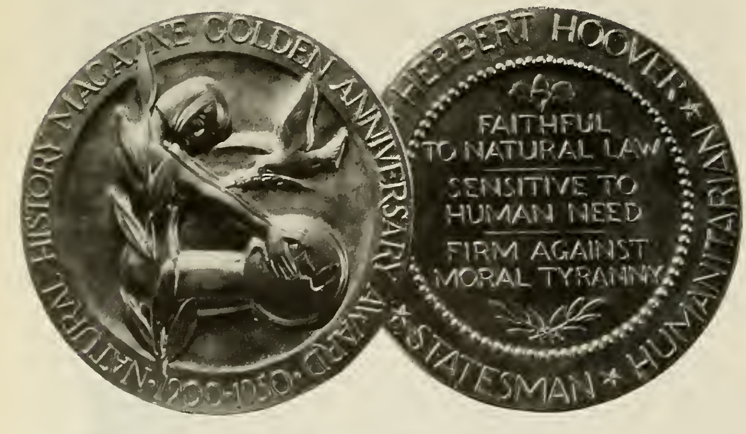
"Reservations" for Interplanetary Trips

Each visitor to the Planetarium's new production, "Conquest of Space," will be given opportunity to make a reservation for one of the first actual rocket ship passenger flights. The applications, issued at a simulated interplanetary terminal reservation desk, will be kept in the Planetarium's archives and will be turned over to the first organized passenger service to the moon, Mars, Jupiter, and Saturn. In the Planetarium production, visitors will have a thrilling "preview" of the sort of inspection tour of the solar system that science may make possible in the not-too-distant future; and the original paintings by Chesley Bonestell for Willy Ley's recent book, *Conquest of Space,* will be on display during the run of the production.

Special Jewelry Display

An unusual exhibit entitled "Silver and Gold with Stones" will display the artistry of a young designer, Yonny Segel, in the Morgan Hall of the American Museum until May 10. Mr. Segel explores the use of uncut stones and emphasizes the design principles that are currently applied in painting, sculpture, and architecture. His sculpture has been exhibited in various museums and galleries, including the Metropolitan Museum of Art and the New School for Social Research. He is now teaching jewelry and plastics to severely disabled veterans at an outpatient clinic of the Veterans Administration and is studying for his doctorate in Education at New York University.

Medal awarded to Herbert Hoover
by Natural History Magazine on its 50th Anniversary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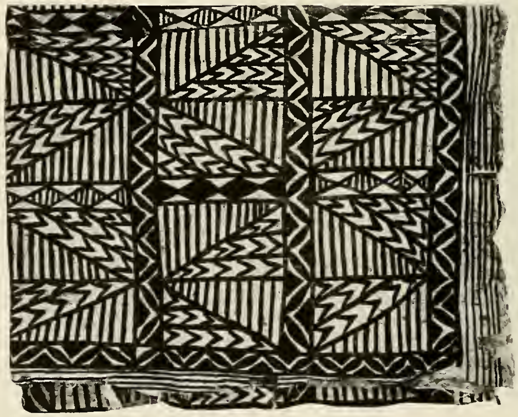
WE have a new stock of these tapas, from Samoa. They are made from the bark of the mulberry tree, pounded under water into pulp, dried, and hand painted with the juice of berries. The designs are varied in assorted shades of brown, and the cloths are suitable as wall decorations or table covers.



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LETTERS

Snowsuit Without Snow

SIRS:

Your readers might be interested in the story connected with the accompanying photograph of a weasel, wearing his winter coat at a time when there was not a trace of snow on the ground.

We were following a trail through a stand of lodge-pole pines in southeastern British Columbia last October 30, when I saw this beautiful animal running through the down timber toward the trail ahead of my lead horse. He flowed over the logs like a ribbon of white silk, and on reaching the trail, stood up like a tenpin to look at us curiously. I stopped the pack train to watch him. As though dissatisfied with his view from the ground, he took to a tree to give us a good looking over.

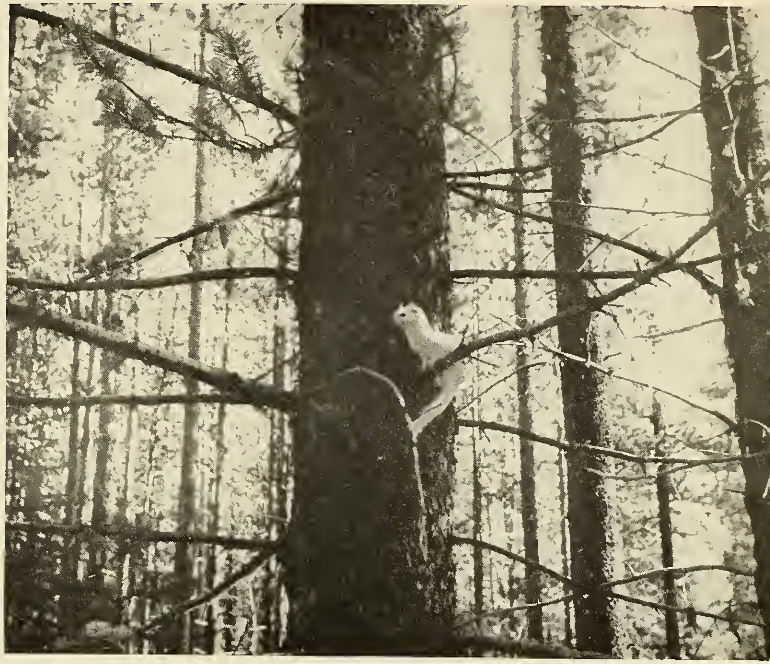
He paid little attention to me when I dismounted and walked closer with my camera. He continued to gaze curiously at the rest of the outfit while I photographed him from about eight feet.

To me, one of the most fascinating aspects of nature is the phenomenon of protective coloration, and this weasel is pictured in the embarrassing position of being clothed in his beautiful white coat without benefit of snow. He showed up in startling contrast to his surroundings.

This picture has additional significance, to which I should like to draw your attention. I am an outfitter and guide, and we are all aware that this profession has long been considered synonymous with the killing of game; but I have introduced a new angle, which has provided endless enjoyment and aroused a growing interest among my friends. I am introducing camera hunting and have induced many to learn of the sport of shooting with film instead of bullets. And I am striving to show the men who follow my profession that, because shortened seasons and smaller bag limits are slowly cutting into the income of guides everywhere, camera hunting provides a wonderful opportunity to increase popular interest in the outdoors and to extend the opportunities through a greater portion of the year.

ANDY RUSSELL.

Twin Butte, Alberta, Canada.



Nature Lovers in the Netherlands

SIRS:

I was delighted to see how many of your readers responded to the notice you published suggesting that young nature lovers might like to correspond with members of the Dutch Youth Association for Nature Study. Many letters have reached us. Not only that, but we were pleased to receive some copies of NATURAL HISTORY and even a gift subscription and membership in the American Museum . . .

This summer, between July 3 and 13, we will have an international field-biology camp at the isle of Terschelling. Though we understand that it won't be easy for Americans to come and attend it, we would be delighted to be able to welcome some of them at this wonderful spot in Holland. The age limit for both boys and girls will be from seventeen to thirty years . . .

HANS ANDREAE.

Leiden, Holland.

Though the camp quota may be full by the time this goes to press, interested readers can obtain further information by writing promptly to Natural History Magazine, 79th Street and Central Park West, New York 24, N. Y.—Ed.

What Is a Robin?

SIRS:

After reading the well-deserved tribute to your Magazine in the April 3 *Time*, it occurred to me that you might be willing to help me and some of my friends in a matter that has bothered us for years, namely, what bird is the true robin.

I am aware of Webster's definition of robin— "a small European bird *(Erithacus rubecula)* of the thrush family," etc., and 2, "In North America, a kind of large thrush (*Tardus migratorius*)," etc. However, this still leaves us with the question as to whether the North American bird is truly a robin or whether it is just so called because it resembles the European bird. . . . And if we must, because of usage, accept the name "robin" for our American bird, is it actually related to the real robin?

To make the subject even more complicated, I lived for some years in the Pacific Northwest, where there is a most lovable and beautiful bird known there as the Marsh Robin. It resembles the European robin much more than the American, but it has a longer tail than either and a redder breast. Many people there consider this bird the real robin, and I can't blame them, because I know of no feathered creature more admirable . . .

ROBERT B. WOOLVERTON.

San Francisco, Calif.

The following comments are offered by

Dr. John T. Zimmer of the American Museum's Bird Department:

Suggestions are occasionally made that our Robin has no right to that name since it properly belongs to a different European species. While the latter part of the statement is true, the name has become so firmly fixed to our bird that it would be difficult to supplant it by another term, even if it were desirable, which is a debatable point. Our Robin was presumably so called by the early English colonists who saw in it a certain degree of resemblance to the well-loved bird of their homeland, and they transferred the old name along with some of the old affection.

It has borne other names in its day: American Fieldfare, Red-breasted Thrush, Fieldfare of Carolina, American Redbreast, and Migratory Thrush. But "Robin" has emerged victorious and is likely to remain. The English bird itself was long called Redbreast in more formal writings, and the affectionate diminutive of "Robert" was added in popular writings and everyday speech to make "Robin Redbreast," possibly in the same vein as "Jennie Wren."

Other birds of the New World were also given names that originally were reserved for European birds. Oriole, Redwing, Tree Sparrow, Redstart, Warbler, Blackbird, and Flycatcher, to cite a few general and specific terms, were given here to birds that are even of different families than the European birds they were thought to resemble. Others, like Goldfinch and Robin, belong to members of the same families, though of different species. When we wish to distinguish the European birds in question, we are likely to prefix "English," "British," "European," or "Old World," while the British, in the same way, call our birds "American Robin," "North American Goldfinch," and the like. As a matter of fact, they call their own Robin the "British Robin" because of the existence of other subspecies on the Continent, one of which reaches the British Isles in winter.

A more troublesome difficulty arises when we and the British use different names for the same species. The respective committees of the British Ornithologists' Union and the American Ornithologists' Union have been attempting to compose some of these differences, and considerable progress has been made, so that greater uniformity is in prospect. There is no need, however, to change the name of our Robin to one of its ancient synonyms or to invent a new term to replace it; and I, for one, hope that no such proposal will seriously be made.

Watch for Marked Butterflies

The Monarch Butterfly, which ranges over practically all the Western Hemisphere, migrates long distances seasonally. Again this spring the monarchs will be flying north once more. An effort is being made to gather information regarding the migration routes, and toward this end the wings of butterflies in Texas have been marked. Readers of Natural History are asked to keep an eye open for butterflies whose wings bear numbers or other marks. Please report any discovery of marked wings to C. A. Anderson, 3209 Centenary, Dallas 5, Texas. He wants to know the kind of butterfly, the number or other mark, the place, the date, and any other pertinent information. Release the butterfly after examination.—Ed.

Golden Anniversary

Sirs:

The Golden Anniversary issue of Natural History is excellent; in truth, every issue is read by my husband and me with much interest, and there is always a race to see which of us gets hold of the Magazine first!

Your editorial, "It's for You to Choose," is a classic in literature. The subject matter is most apt for the moment in history, the way you handled it is superb, and the inspiration—well, it was too good not to pass on, and I have just suggested to the Editor of the *Atlanta Journal* that he should reprint it . . .

Mrs. Athos Menaboni.

Atlanta, Ga.

Sirs:

Enclosed please find check for $5.00 for which please send us ten copies of the April 1950 Golden Anniversary number of Natural History. We have in mind to use the copies to deepen the interest in natural history, and perhaps there may be a new regular reader for the magazine.

This order is our testimony of appreciation for your Golden Anniversary number. Every single one of its pages deserves a "Thank you." But we wish particularly to commend Edward M. Weyer, Jr. for his editorial, "It's for You to Choose." . . . Our good wishes reach toward you in your ministry of education.

Robert H. *and* Ruth O. Maris.

Wilmington, Del.

Sirs:

I want you to know how deeply moved I was in reading "It's for You to Choose" in the April issue of Natural History. This editorial should be read by every legislator and minister in the United States. Thanks for putting it all so clearly in so few words.

Mrs. Leonard H. Gidding.

Plainfield, N. J.

Separate copies of "It's for You to Choose" can be procured at 5¢ each or 25¢ a dozen.

Sirs:

Congratulations to Natural History Magazine on its Fiftieth Anniversary and to its able editors and contributors. May the Magazine always be a cheerful monthly visitor to our many homes and continue to bring pleasure and worthwhile knowledge.

E. B. Powers.

San Diego, Calif.

Sirs:

May I comment that I personally consider Natural History Magazine one of the best that comes into my home. We subscribe to seventeen magazines (which we turn over to friends or to the hospital after we have reviewed them), and there are only two in this list that I read with regularity. One of them is the American Museum's Magazine, which you can see I consider tops. The articles are invariably on subjects that are interesting, and they are always brief, instructive, and very well written.

Dudley S. Ingraham.

The E. Ingraham Company,
Bristol, Conn.

"Man in Whale"

Sirs:

I was pleased and amused to see that "we" made *Time* Magazine [April 3] together. Hope it is no source of embarrassment. Had never intended it as such.

Continue to love your Magazine—pine aroma and all.

Your obedient servant,
Egerton Y. Davis, Jr.

No address.

Readers will be reminded of the letter entitled "Man in Whale" published in Natural History in June, 1947, and its sequel in September. Not yet having been able to ascertain the whereabouts of Egerton Y. Davis, Jr., we take this method to inform the good "surgeon" that he did not cut us up any more seriously than he did the whale. The wounds have healed nicely.—Ed.

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The Magazine of the American Museum of Natural History

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MAY, 1950

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THE COVER THIS MONTH

The Green-clouded Swallowtail is a familiar butterfly of our fields and gardens. The green clouds appear only on the hind wings of the male. The female has blue clouds instead. In this sense, the popular name might be called misleading. Another name for this butterfly is the Spicebush Swallowtail, resulting from the habit of its caterpillars to feed on the leaves of spicebush. But again there is a difficulty, for the caterpillars like sassafras just as well. Linnaeus, nearly 150 years ago, called this butterfly *Papilio troilus*, after Troilus, the son of Priam, king of Troy, whose story is told by Homer in the Iliad. Really, "Troilus Swallowtail" seems to be the best name of all. The caterpillars are colorfully patterned when fully grown, with eyelike spots on the deep green body, on either side of the thorax. They make tubular nests by curling a leaf about themselves for concealment. The Troilus Swallowtail may be found in most parts of the Mississippi Valley and eastward.

William P. Comstock.

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YOUR NEW BOOKS

Nature of Natural History • Maine Woods
Nature Crafts • American Horticulture

CONGO EDEN

- - - - - by Mary L. Jobe Akeley

Dodd, Mead and Co., $5.00
356 pp., 27 illusts.

CONGO EDEN is the story of Mary L. Jobe Akeley's return visit to the Kivu District of the eastern Belgian Congo, after an absence of 20 years.

In 1921, Carl Akeley had first visited this scenic region of volcanic mountains and heavy forests. He headed an expedition to collect specimens of the mountain gorilla and also the accessories for a group of this animal for the new African Hall, now known as the Akeley Memorial African Hall, in the American Museum of Natural History. He returned to New York very enthusiastic about the country, which he often referred to as "the most beautiful spot on earth." His chief desire was to have these mountains remain unspoiled and their unique flora and fauna saved for posterity. It was largely through his influence that, in 1925, the Albert National Park, the first of the new famous National Parks of the eastern Belgian Congo, was created. In 1926, one year later, Mrs. Akeley accompanied her husband into the Kivu District for the purpose of making additional studies and collecting more accessories for the Gorilla Group, which was nearing completion. While undertaking this task, Carl Akeley was laid at rest in the very spot he cherished so dearly. Fortunately he had seen the beginning of his great ambition—to save the beauty and grandeur of these mountains.

The task of finishing her husband's field work fell upon Mrs. Akeley, and she most ably accomplished it.

In 1946, 20 years after Mary L. Jobe Akeley's first visit to the Kivu, she received an invitation from the Belgian Government to be their guest on a tour of the National Parks in recognition of Carl Akeley's interest in their foundation. The tour would also include a visit to her husband's grave. The invitation was accepted, and *Congo Eden* is her story of this trip.

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Mrs. Akeley writes most informatively of the many happenings, including her trip through the Ituri Forest with its pygmies, and her many experiences in photographing big game. She gives interesting facts about the animals, describes the strange types of flora observed, and tells of the interesting people she met. She dwells at length on the accomplishments of the Belgian Government in educating the natives and in the development of agriculture. There are descriptions of the volcanoes and a chapter devoted to her visit to her husband's grave.

Mrs. Akeley has written with her usual easy-to-read, instructive style. I enjoyed the book and am glad to recommend it.

T. DONALD CARTER

A HISTORY OF HORTICULTURE IN AMERICA TO 1860

- - - - - - - - - by U. P. Hedrick

Oxford University Press, $7.50
551 pp., 62 illusts.

DR. HEDRICK'S retirement from the directorship of the New York Agricultural Experiment Station a dozen years ago meant merely a redirection of his activities, which since then have found expression in a series of books. This latest one shows that the passage of 80 seasons has not blunted the enthusiasm of its veteran author. He has ranged widely, gleaning here and there, and has collated his notes into a well-planned survey of early horticulture in the United States (rather than America). The book is as readable as it is informative and will be of value not only to horticulturists but also to students of our national development.

In sweeping over such a wide field, it was perhaps impossible to achieve complete coverage or complete accuracy, but there are some surprising omissions, such as the first Flower Show (Philadelphia, 1829) and the first book on botany (Adam Kuhn's, 1803) or the subsequent course of these subjects. The dahlia is mentioned but not the equally American and more popular marigold or zinnia; also the mulberry but not tea. The invention of the commission box of packeted seeds is rightly attributed to the Shakers, but on a later page to D. M. Ferry 60 years afterwards. Actually the man who promoted the Shakers' idea was William G. Comstock of Wethersfield, Conn., who rode the frontiers with his seed boxes in a wagon. The repeated story of the introduction of sweet corn into New England by Lieut. R. Bagnal has been shown by Erwin of Iowa to be a myth. In the phenomenal rise of this crop the pioneer breeding work in 1836-44 of Judge Noyes Darling, Mayor of New Haven, has been overlooked. The Jerusalem artichoke got its misnomer not from *girasole* but from London hawkers crying it as Ter Neusen, where the crop was grown.

The bibliography is ample but strangely omits Bailey's Cyclopedia of Horticulture, to which the author was clearly indebted. Still, when we have so much in this book, it is almost captious to notice the flaws rather than the excellences with which it abounds. A word of praise is due to the Press for the design and production of a volume which augments its high standards.

F. C. COULTER

THE MAINE WOODS

- - - - - by Henry David Thoreau
Edited by Dudley C. Lunt.
Illustrated by Henry Bugbee Kane

W. W. Norton, $3.00, 340 pp., 72 illusts.

ON the last day of August, 1846, Henry Thoreau left his cabin at Walden Pond for the first of three trips to the Maine wilderness. At the time of his death, in 1862, he was shaping his journal entries and essays into a book, *The Maine Woods*. Edited by his friend, William Ellery Channing, the volume appeared two years later, in 1864.

It has since reappeared in many editions. The most attractive of all, in a number of ways, is the latest, edited by Dudley C. Lunt and illustrated by Henry Bugbee Kane. In previous editions, the book consisted of three separate essays, covering the three trips. By "using the

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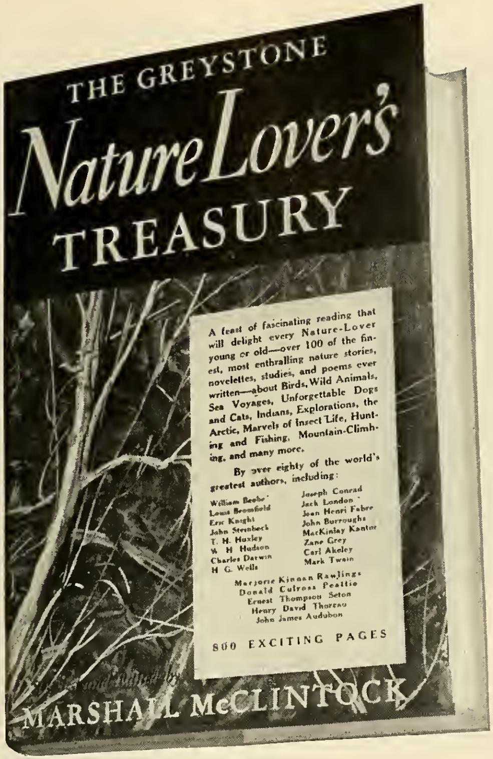

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route followed by the river trip of 1857 and dovetailing into it at the appropriate places the 1853 excursion to Chesuncook and the ascent of Ktaadn in 1846," the editor of the present volume has produced a more consecutive book, smoother to read and ending in the natural climax of the Ktaadn ascent. The gifted Mr. Kane, many of whose Kodachrome pictures have appeared on the covers of NATURAL HISTORY Magazine, has contributed more than 60 black-and-white drawings, 15 of which are given full-page display. In their wide variety, they combine to a remarkable degree dramatic art and the accurate delineation of scenes and wildlife.

While *The Maine Woods* is less philosophical than Thoreau's masterpiece, *Walden,* it contains some of the best forest writing in print. An American poet, recipient of the Pulitzer award, recently told me he considered one short paragraph in the book, describing the sound of a falling tree in the forest, as the most nearly perfect paragraph he knew. You can find it on page 70. In *The Maine Woods,* Thoreau, far in advance of his time, made the first eloquent plea in American literature for wilderness conservation. "Every creature," he wrote, "is better alive than dead, men and moose and pine-trees, and he who understands it aright will rather preserve life than destroy it."

EDWIN WAY TEALE

NATURE CRAFTS

- - - - - - - - by Ellsworth Jaeger

The Macmillan Company, $2.49
128 pp., 70 plates

THIS attractive little book was prepared for campers, outdoor students, and those thousands of persons who are taking training courses in outdoor leadership. Along with schools, universities, churches, state and national parks, many museums are now providing nature courses. Ellsworth Jaeger, Curator of Education and Hayes Professor of Sciences at the Buffalo Museum of Science, has long been interested in nature crafts. This book is replete with easy-to-understand drawings by Mr. Jaeger and simple directions for the making of over 70 interesting nature craft projects. Mr. Jaeger carries on the tradition of Ernest Thompson Seton by interpreting nature through both word and picture.

The shops that supply craft materials may not be too pleased with a book of this type, for all of the materials used to produce the projects come from the fields, woods, and even vacant lots. Nor will the reader need to equip himself with a large assortment of tools. In addition to a pocket knife, only a few tools are needed, such as an ax, a saw, a bit and brace, a gouge, and scissors. Many of the projects are functional, such as a thatched hut, benches, stools, mats, spoons, gourd dippers, fish hooks, fire makers, turkey callers, candles, match holders, and snowshoes. Other nature crafts provide projects of the recreational type, such as equipment for games like lacrosse and snow snake, the carving of totem poles and Indian dolls, and the modeling of animal figures in clay. This is a crafts book of first quality, which will introduce many readers to a functional and satisfying aspect of their natural surroundings and provide many hours of pleasure. It should be a stimulating antidote for the artificial character of our mechanized and vicarious mode of life.

John R. Saunders

AMERICAN WILD FLOWERS

------ by Harold N. Moldenke

D. Van Nostrand Company, Inc., $6.95
453 pp., 88 full-color photographs,
67 in gravure

WE have on hand the first volume of "The New Illustrated Naturalist," and it is quite appropriate that this should take the form of a nation-wide treatise on flowering plants. This book represents a very considerable undertaking, for Dr. Moldenke estimates that 30,000 species of flowering plants grow in North America north of the Rio Grande.

He first conducted a nation-wide poll to find out what were the most popular native plants. It will not surprise anybody to know that the cardinal flower and the showy lady's slipper headed the list. Various regional floras were abstracted for descriptions of the interesting, more or less spectacular species that visitors or tourists are likely to find. These plants are described under family headings to give the book scientific integration. Fifty such chapters form the main text, beginning with "Buttercups and their Relatives" and ending with "Orchids."

Some of the Kodachrome illustrations are better than others; the unevenness in quality is probably due to the fact that they have been taken by a large number of people. The black-and-whites are uniformly good, with a fine soft contrasting background, those of the elk grass and Indian pipe being especially handsome. Running comment in these chapters provides information about the plants—how they grow, various types of pollination, their uses, and their geographic distribution. There is an extensive bibliography.

The amateur botanist, for whom the book is intended, may be surprised at the number of scientific names that appear unfamiliar. The author explains in an introductory statement, "Further study has shown the advisability of dividing an old genus of perhaps a great many discordant elements loosely held together by a single or but a few tenuous characters into several smaller but more homogeneous genera." The diversity of names that has resulted is a phenomenon not limited to the botanical field. Then the agglutination of common words into compounds is at times disconcerting—words such as "midasears," "Floridamimosa," "falseindigos," "jobstears," and "adobelily." Nevertheless, the book is beautifully set up, with excellent paper and printing, and the 2000 plants that are discussed will provide a sufficient background for the most insatiable amateur.

Henry K. Svenson

THE NATURE OF NATURAL HISTORY

---------- by Marston Bates

Charles Scribner's Sons, $3.50
309 pp.

THIS is an excellent book, strongly recommended to all readers of Natural History Magazine and still more enthusiastically to anyone who may think that natural history is no concern of his.

Since the days of Darwin, Wallace, another Bates (Henry Walter, of Amazonian fame), and the other great naturalists, natural history has been transformed in two directions. The scientist has largely ceased to be a naturalist and has become an ecologist, a mammalogist, a paleontologist, or some other highly special sort of -ologist. To the amateur and the popularizer, natural history has become mainly "nature loving" and its literature is too largely of what Marston Bates calls the "oh my!" variety.

Now Bates proposes to pull natural history together again. For the scientist, here is a large common field among many -ologies, all of which gain by their contribution to a broader synthesis of studies of plants and animals as individuals and in associations. For the amateur, Bates hopes to supplement nature loving with nature *understanding* and to replace "oh my!" with "why?"

This is a tremendous field to cover. Among many other things, it includes the naming and classifying of organisms, their history, their reproduction and development, their environments, their associations, their behavior, their geographic distributions, their adaptations and evolution, and their importance in human economy. The facts are, of course, greatly simplified and generalized in covering so much in one book, but they are never essentially falsified and a real feeling for their trend and significance is conveyed. Moreover, the reader is given a stimulating personal experience. He learns much of the reasons and methods of biological science and of its meaning for him.

All this is conveyed in language so clear that anyone beyond (and some in) grade school should be able to understand it, but so free of condescension that the highest or most learned intelligence will not be insulted.

G. G. Simpson

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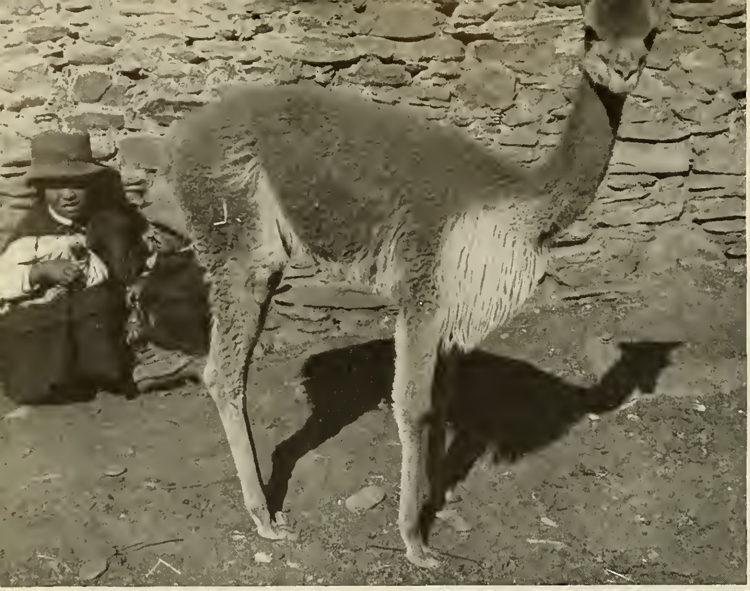


▲ THIS VICUÑA, now grown, was captured with its twin at two months of age when its mother was shot. The photograph shows well the ruff of long hair below the neck

➤ VICUÑALAND: high pampa country at 15,000-foot altitude in southern Peru. This scant, semiarid vegetation typifies the homeland of the little prince among camels. The old volcano El Misti, in the background, lifts its snowcap to a height of 19,110 feet

The little "camel" known as the vicuña, whose superfine wool has been the pride of kings, may provide the basis for a new industry

By WALTER HENRICKS HODGE

University of Massachusetts

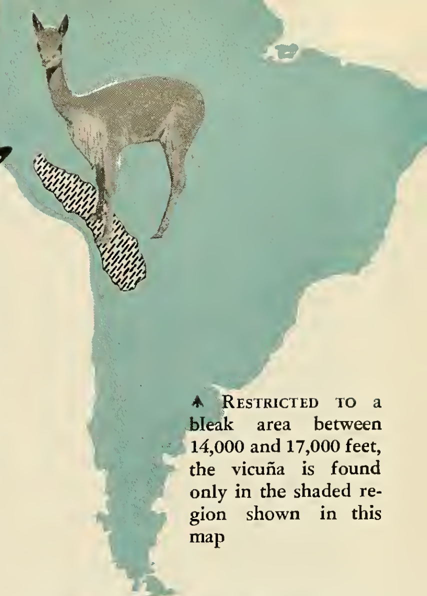
Photographs by the author except where otherwise credited

UNLIKE the mythical fleece of Jason, no sleepless dragon guards the haunts of the vicuña, the little Andean beast with the Golden Fleece. Nor need one be a mythological Jason to quest for this regal fleece. Yet only one person in every four million enjoys the beauty and warmth of fabrics woven from the golden-brown wool of the vicuña. Why? Because of scarcity of supply. Though the vicuña may become a plentiful animal under domestication, you may now have to pay upward of $1,000 for a garment made of its wool! Little wonder that most people have never heard of the vicuña, a little camel that often has been called the prince of wool bearers.

This is unfortunate, for the fleece of this animal surpasses in fineness that of any other. A single vicuña hair is less than one-half the diameter of the hair of the finest strains of sheep. Beside it, a human hair would look like coarse wire. Indeed, vicuña is to wools what chinchilla is to furs. It is truly "the most beautiful textile fiber." It is not surprising that this golden fleece, so fine and so regal, was originally reserved exclusively for royalty—the Incas—or that at the time of the Conquest, the Spaniards had a royal quilt made as a gift for their sovereign, Philip II.

Vicuñas, like their close relatives the more familiar llamas, guanacos, and alpacas, are South American camels (Camelidae). Although camels are generally thought of as Old World animals, their ancestral dwelling place actually encompassed large parts of North America,

Fleece of the Andes



▲ Restricted to a bleak area between 14,000 and 17,000 feet, the vicuña is found only in the shaded region shown in this map

on whose broad plains they developed in large numbers from 12 to 58 million years ago (Eocene to Miocene times). These prehistoric North American camels looked more like their modern South American descendants than like the ungainly humped creatures of Africa and Asia. By the end of the great Ice Age (Pleistocene), camels became extinct in North America but not before they had migrated into the Old World and also into South America, where they evolved through the centuries into two now widely separate and superficially distinct types of creatures.

The vicuña (*Vicugna vicugna*) is the handsomest of our Western Hemisphere camels. It is also the smallest (only two and a half feet high at the shoulders) and the most graceful, being deerlike in appearance and movement. Despite its delicate appearance, the vicuña is actually the hardiest of the Andean camels. Llamas and guanacos cannot stay long at the bleak, blizzard-swept altitudes inhabited by these creatures. Only the alpaca can wander occasionally into these heights. Indeed, save for the rare little deer called *taruga*, vicuñas are the only large mammals in their mountaintop abode.

The vicuña's haunts include the veritable heights of the Andes. Only the line of perpetual snow and ice (which effectively bars the upward growth of animal pasturage) keeps this little camel from clambering above about 17,000 feet on the slopes of some of the loftiest peaks in this part of the world. Wedged in between the snow line on the one hand and the upper limits of crop cultivation on the other (approximately 14,000 feet) lies the belt that the vicuña can call home—a cloud-scraping homeland that averages considerably higher than the summits of Pike's Peak, Mt. Rainier, or the Matterhorn! This treeless land is called *puna*. It is a sort of Andean tundra, with extensive rock fields or semibare earth. It supports sparse bunch grasses called *ichu*, curious mounds of cushion plants, and, in the poorly-drained hollows, vivid green moors of short rushes. These moors serve the vicuñas for herbage, and it is around them that the animals are most frequently seen, particularly in the dry season (April to December).

A Visit to Vicuñaland

Today one can climb by automobile into many parts of the puna country, and if lucky, one can catch a fleeting glimpse of these "substratosphere" camels. But to stalk them away from the road across the high pampas is another matter. Even on the level, the breath of the average person, in an atmosphere drained of life-giving oxygen, comes in short gasps. *Soroche*, or mountain sickness, except for the barrel-chested, big-hearted highland Indians, is an ever-present worry. Like the Indian, the vicuña is attuned physically to life at high elevation. So specialized is this creature that if transferred to sea level it often sickens and dies.

One might think that in a treeless area where the highest bunch-grass clump is scarcely two feet high, vicuñas would be easy to see. On the contrary, except when in motion or when silhouetted against the sky, they are practically invisible, so well does the color of their fleece blend into the perennially-drab brownish aspect of the puna.

The coats of llamas and alpacas, through endless selection in domestication, have become diversified so that one sees various combinations of browns, blacks, grays, and whites. But the undomesticated vicuña has only a single constant color pattern. This is so beautiful a gradation of hues that when fabricated it is rarely dyed. Rich chestnut-brown is the dominant color covering the upper parts of the head, neck, back, flanks, and legs. As it passes to the underparts, this hue is diluted to a soft, golden fawn color and finally to white on the belly and the inside of the thighs. Also light is the short wool of the jaws and face. But perhaps the most striking feature of the adult animal is the conspicuous ruff of long, soft, white hair which, partially surrounding the base of the slim neck, falls down over the chest and makes the dainty forelegs appear to project from wispy plumes of wool, giving an almost birdlike aspect. The white ruff is a sign of maturity and is lacking in lamb vicuñas, which, however, show signs of where the ruff is to appear. Moreover, lambkin vicuñas are much lighter in color—all fawn—and softer coats than theirs are hardly imaginable. They surpass in fineness and silkiness even those of their parents, a fact that was put to practical use by the ancient Peruvians, who made special fabrics from such fleeces. Alpaca hair also varies according to age, sex, and location, and some alpaca hair is actually finer than the thicker vicuña hair.

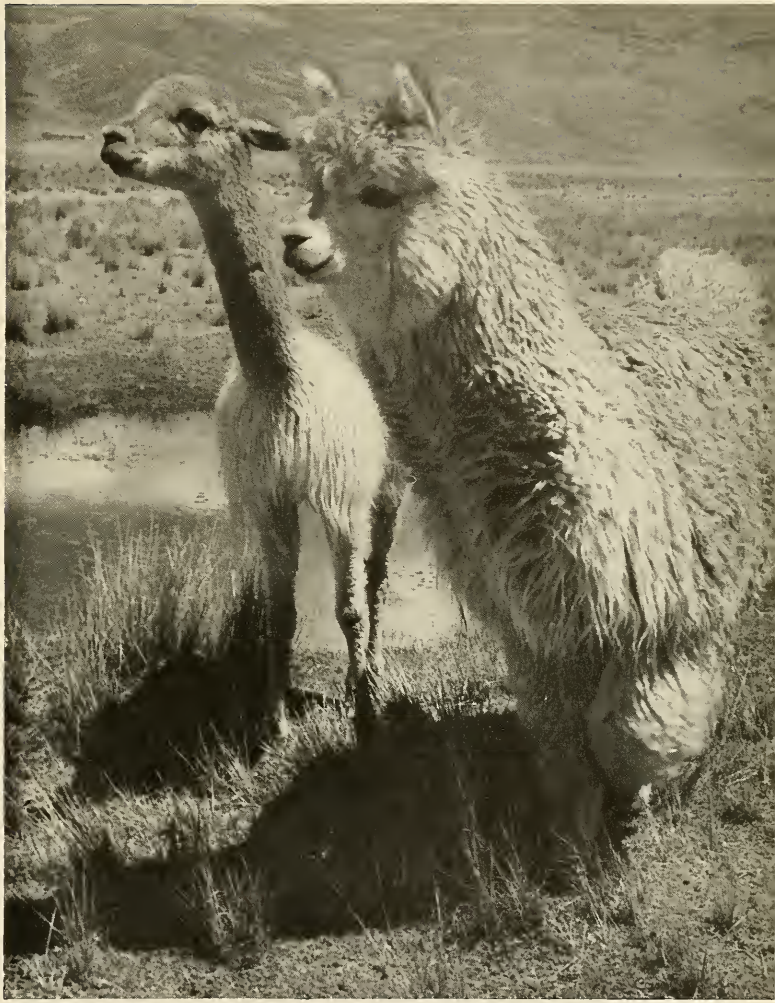
On the puna, vicuñas run in small

▲ **Over the rim** of these giant walls of central Peru lies the lofty domain of the little camel with the golden fleece

➤ **Tending baby** while she shears a hobbled ram, this Indian woman of Ayavaca, Peru, cuts the wool with a crude knife blade in exactly the same way in which her ancestors sheared wild vicuñas

groups of from six to twelve animals. These are all females and young except for the leader, which is a vigorous male. Over a century ago, the distinguished Swiss zoologist Von Tschudi ably described the daily activity of such a vicuña family group: "Whilst the females are quietly grazing, the male stands at the distance of some paces apart and carefully keeps guard over them. At the approach of danger he gives a signal, consisting of a sort of whistling sound and a quick movement of the foot. Immediately the herd draws closely together, each animal anxiously stretching out its head in the direction of the threatening danger. They then take flight; first moving leisurely and cautiously, then quickening their pace to the utmost degree of speed; whilst the male vicuña, who covers the retreat, frequently halts to observe the movements of the enemy. The females, with singular fidelity and affection, reward the watchful care of their protector. If he is wounded or killed, they gather round him in a circle, uttering their shrill tones of lamentation, and they will suffer themselves to be captured or killed rather than desert him by pursuing their flight. The neigh of the vicuña, like that of the other animals of its class, resembles a short, sharp whistle. But when the shrill sound vibrates through the pure puna air, the practiced ear can readily distinguish the cry of the vicuña from that of the other animals of the same family."

Von Tschudi might have added that, like many wild things, vicuñas seem to have a big bump of curiosity, which undoubtedly has led



▲ Compared to the poodle-like alpaca (*right*), an adult vicuña is a dainty, deerlike creature. However, its depressed ears are a warning that a wad of spittal is about to be sent in someone's direction

more than one to its demise. Upon the approach of anything strange, instead of running straight away, they lope off a bit and turn to observe. If no danger is apparent, they generally approach cautiously and linger for a long while. The writer, when traveling by car, has more than once come upon such a group. They seemed to consider the automobile inoffensive, in fact worthy of investigation. But as soon as a person stepped out, the group would hurry off over the horizon. Their fleetness has been their safety. This, together with the absence of firearms among the highland Indians and the stringent laws that supposedly protect them, accounts for their survival today. For certainly an animal with a golden fleece so valuable would long since have been exterminated in the centuries following the Spanish Conquest.

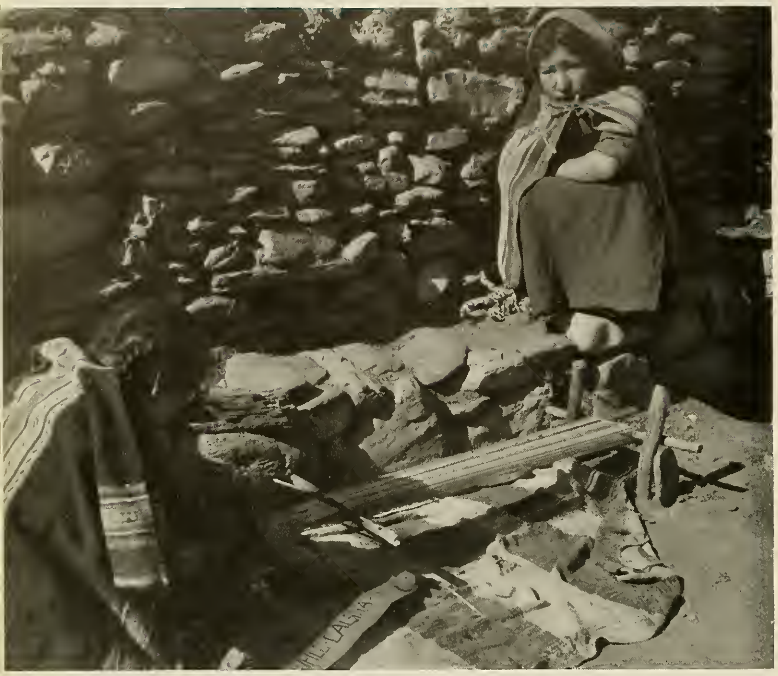
Ancient Conservation

Actually, the vicuña was better protected before the conquest of Peru than it is today—protected by this hemisphere's (and possibly the world's) original conservationists, the Incas. Their civilization recognized the value of vicuñas—and all other game—and enacted laws accordingly. These laws worked, too, for under the Incas anyone molesting one of these little camels, except in one of the orderly state-run hunts, was subject to death. One might say that the vicuña was a royal animal. Dainty vicuña figurines were wrought in gold, silver, and stone; and vicuña fleece was woven into fabrics reserved only for the nobility.

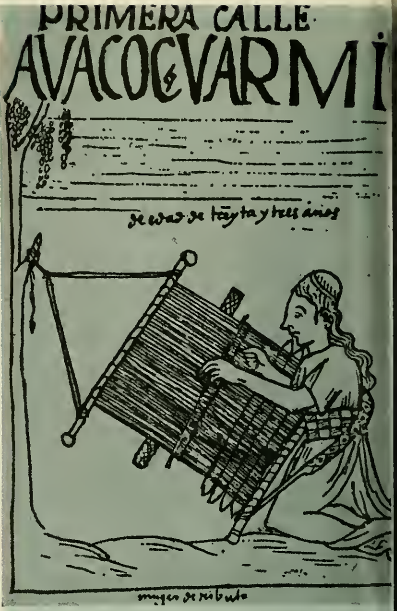
Vicuña fabric of any sort was called *cumpi* by the Incas. Much of it was woven by men, the so-called *cumpi-camayoc-cuna,* on curious upright looms that have long since disappeared. Certain types of *cumpi* were better than others, that from lambkin vicuña surpassing that from adult fleece. The finest *cumpi* was woven by the chosen women (*aclla-cuna*) or Virgins of the Sun, the Incas' handwomen. It is even said that they improved it with the even silkier hair from bats, of all things. But little credence can be placed in this story, because the longest fur from any Peruvian bat is only 7 or 8 mm. in length, and spinning such a short staple by hand would be impossible.

Vicuña wool, in preparation for thread making, was washed in water but never thoroughly. The natural animal oils were valued, in combination with the spinner's saliva applied by the thumb and forefinger, to produce a woolen thread that was remarkably pliable and smooth. The ancient process of thread making has been handed down to the modern Indians, and wherever one sees them, even when they are backpacking burdens or children, one may spot the ever-present distaff and whirling spindle.

From the hands of the chosen women of ancient Peru have come some of the finest wool textiles ever made anywhere in the whole world. Before Europeans reached South America, thread was being spun and woven by Andean Indians into tapestries so fine as to show a weft count of 350 weft threads to the



▲ A **wool belt** being woven by Indian girls of Sandia, Peru. This is a variant of the backstrap loom, in which tension is varied by leaning back on a strap around the weaver's waist



▲ A **backstrap loom** of a type still used in Peru today. On such looms, fabrics of almost all types can be made if the weaver has skill and patience

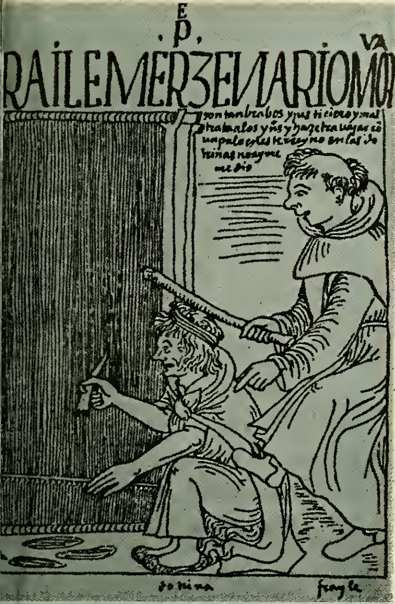
inch. Yet the best that modern man has been able to produce from fine vicuña wool is a weft count of 90! The rarity of true vicuña weavings is shown by the fact that, although there is no doubt of their existence in ancient times, we know of no unquestionable example among the collections in museums. Many pieces have not been subjected to the specialized microscopic analysis that is necessary to ascertain the identity of vicuña hair, but the ones that have, have proved to be alpaca. Unfortunate it is that such a luxury art as that of *cumpi* weaving was suppressed by the Spaniards and its technique of manufacture lost through the centuries, perhaps forever.

In Inca times vicuña wool was obtained systematically during one of the great public hunts called *cako* or *chacu*, sporting events that were held periodically and served not only to reduce the surplus game but also to increase the meat supply. We have an authentic account of one of these imperial hunts, for one was organized in honor of Pizarro by Manco Inca. In this particular hunt more than 10,000 Indian beaters surrounded an area approximately 50 miles in circumference. Closing in gradually, they drove all encircled animals into a common center, and when the human net was tight enough and small enough, designated hunters entered to kill the animals required. Of the animals thus trapped, only the vicuñas were ordinarily taken alive and shorn, presumably being hog-tied during the process. Simple bronze or copper knives, the only metal tools available, were probably used in the shearing. And even today a simple knife is the shearing implement of the highland Indian in vicuñaland.

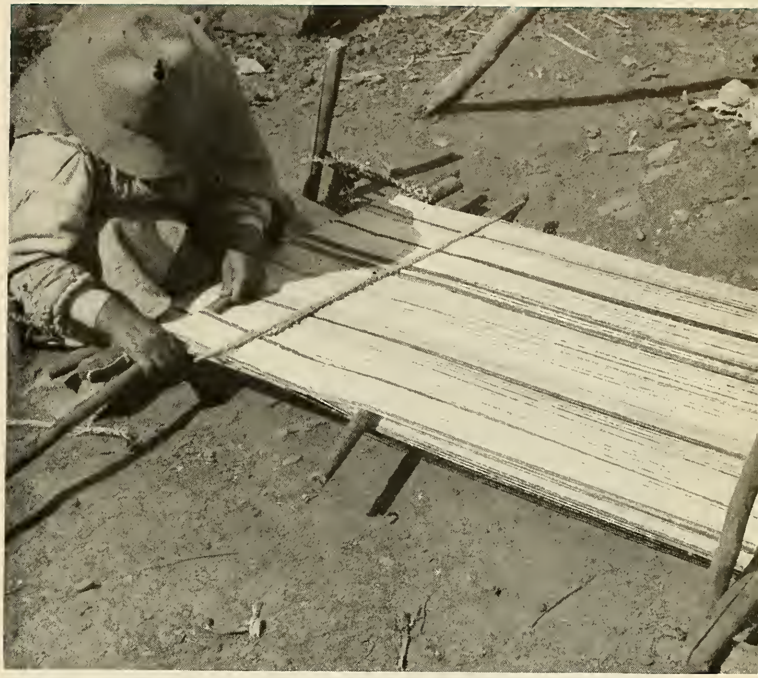
Did the Incas attempt the domestication of this beast with the golden fleece? As they had no written language, we can only say we do not know. But since ancient Peruvians domesticated the closely related alpaca and llama, we might guess that they tried to tame the vicuña and failed. Or, since vicuña wool was reserved for the royalty, perhaps it was better left a relative rarity to be obtained from the wild only through the medium of the public hunt.

The Threat of Extinction

With the conquest of the Incas by Europeans, all their strict and able conservation practices failed. The Conquistadores could scarcely believe that the fine vicuña textiles that fell to their plundering hands were made from a wool. Instead they thought it was some New World kind of silk. As with the other riches of Peru, greed got the best of the conquerors. No sooner had



▲ **A VERTICAL LOOM** used by select men weavers for making fine tapestry cloth. This type was last used shortly after the Conquest



▲ **A WOOL PONCHO,** universal outer garment of the highlands, being woven on a loom stretched between stakes. Ponchos made of vicuña cloth are still highly prized, being noted for lightness, softness, and well-nigh impermeability to rain

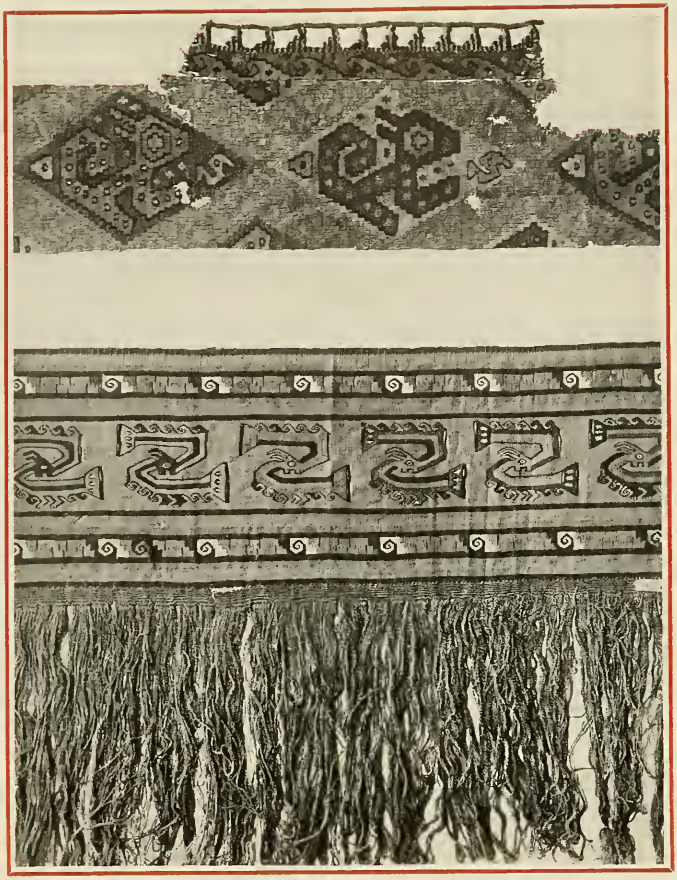
they learned of the true source of this New World "silk" than slaughter of vicuñas became wanton. The animals shortly approached the verge of extinction, if one is to believe the writers of the time. By the beginning of the nineteenth century, the time of Peruvian independence, the stock of these little camels had been so decimated that in 1825, Bolivar enacted a decree prohibiting their killing. The Liberator further offered prizes—without success—for the vicuña's domestication.

Compared with Inca times, the vicuña population was sadly depleted, but possibly it is erroneous to say it was on the verge of extinction. For there are so many isolated, uninhabited *refugia* in the high puna country, even today, that to kill all the vicuñas would seem to be next to impossible. Von Tschudi, who was certainly a careful scientific observer, noted about this time (1838-1842) that "frequent hunting seems not to have the effect of diminishing the numbers of these animals . . ." In the altos, he said, they were still found in vast numbers. The same writer took part in a variation of the old Inca hunt, which apparently is still promoted today, occasionally and furtively, by the highland Aymara Indians of the Titicaca area. Von Tschudi's description is worth quoting:

The Hunt

"In this curious hunt, one man at least belonging to each family in the puna villages takes a part, and women accompany the train, to officiate as cooks to the hunters. The whole company, frequently amounting to seventy or eighty individuals, proceed to the altos (the most secluded parts of the puna), which are the haunts of the vicuñas. They take with them stakes and a great quantity of rope and cord. A spacious open plain is selected, and the stakes are driven into the ground in a circle, at intervals of from twelve to fifteen feet apart, and are connected together by ropes fastened to them at the height of two or two-and-a-half feet from the ground. The circular space within the stakes is about half a league in circumference, and an opening of about two hundred paces in width is left for entrance. On the ropes by which the stakes are fastened together the women hang pieces of colored rags, which flutter about in the wind.

"The *chacu* being fully prepared, the men, some of whom are mounted on horseback, range about within a circuit of several miles, driving before them all the herds of vicuñas they meet with, and forcing them into the chacu. When a sufficient number of vicuñas is collected, the entrance is closed. The timid animals do not attempt to leap over the



◄ **Though not** a single sample of ancient vicuña weaving appears to have been identified by actual tests, this remarkable tapestry border of alpaca illustrates the exquisite weaving of the late Chimu period (A.D. 1000-1400). Colors are crimson, deep pink, yellow, black, and white, and they are woven with superb symmetry and harmony

▼ **Spinning vicuña wool** by the ancient method handed down from Inca times: a highland woman using the typical wooden distaff in her left hand and the spindle in her right

ropes, being frightened by the fluttering rags suspended from them, and, when thus secured, the Indians easily kill them by the *bolas.* These bolas consist of three balls, composed either of lead or stone; two of them heavy and the third rather lighter. They are fastened to long elastic strings, made of twisted sinews of the vicuña, and the opposite ends of the strings are all tied together. The Indian holds the lightest of the three balls in his hand, and swings the two others in a wide circle above his head; then, taking his aim at the distance of about fifteen or twenty paces, he lets go the hand-ball, upon which all the three balls whirl in a circle and twine round the object aimed at. The aim is usually taken at the hind legs of the animals, and the cords twisting around them they become firmly bound. It requires great skill and long practice to throw the bolas dexterously, especially when on horseback: a novice in the art incurs the risk of dangerously hurting either himself or his horse, by not giving the balls the proper swing, or by letting go the hand-ball too soon.

"The vicuñas, after being secured by the bolas, are killed, and the flesh is distributed in equal portions among the hunters. The skins belong to the Church." The chacu hunt described by Von Tschudi took place in the altos of Huayhuay, and during the five days of the hunt, 122 vicuñas were caught.

Laws to Protect the Vícuña

During the hundred years since Bolívar first acted to conserve the vicuña, protective laws have been sporadically reinacted by the Peruvian government. Rigid control of hunting is impossible in a country without game wardens, but these laws are certainly a step in the right direction. As recently as 1940, a decree was passed prohibiting the killing of vicuñas or the possession of any articles made from their skin or wool. That the law has its infractions may be judged from the fact that a traveler in puna territory may easily, if at times furtively, acquire articles from the natives such as vicuña-skin robes, hats made of vicuña felt, or vicuña woolens. Although obtainable, they are difficult to get out of the country except with official permits. Moreover, nearly every highland village boasts of one or more tame vicuñas, animals usually captured as lambs (when a female is killed) and then reared as pets.

Despite these minor infractions of the law, the vicuña is fortunately not uncommon today in some places, especially in the outlying fringes of the altiplano. Although listed in 1942 as a vanishing mammal of the Western Hemisphere, the present status of this little camel is hardly that. In Peru alone, estimates of the wild vicuña population run from a conservative (and more probable) fifty thousand animals to an optimistic million. These figures are little more than guesses.

Attempts at Domestication

Modern Peruvians are showing signs of accomplishing what the ancient people failed to achieve—the domestication of this beast with the golden fleece. If practical, this should bring a new and profitable industry. Several large private haciendas in Peru's state of Puno already have small experimental flocks of vicuñas for husbandry study. Most of these animals were captured by running them down on the puna with horses, a difficult job. Peru's National Board of Wool Industry is behind these studies. Even with abundant terrain for their project, problems still exist. Though easily and frequently tamed, vicuñas usually refuse to breed in captivity, thus making the building up of a commercial flock most difficult. But if given ample space, simulating wild conditions, it has been found that vicuñas may breed within a fenced area.

Sizable flocks are needed, because the little beasts produce only about a third of a pound of fine wool per adult animal. About a third of this represents the longer beard hair comprising the vicuña's outer coat—useless in fine textile manufacture. The remaining two thirds, about a quarter of a pound all told, is the silklike inner hair yielding the stock for fine vicuña fabric. Thus the annual wool production from a pioneer flock of 300 domesticated vicuñas is only 100 pounds, barely enough to make half a dozen fine coats. No wonder yardage of vicuña fabrics is valued in the hundreds of dollars!

To increase the wool production, experiments have been made in crossing the vicuña with its cousin the alpaca, the most important of South America's "camels" as far as wool production is concerned. Such hybridizing has been successful, and the hardy progeny of these crosses, known as paco-vicuñas, show the heavy wool production of alpacas with some of the finer characteristics of vicuñas. Unfortunately, the characteristics of the original cross do not hold in succeeding generations, the wool decreasing in value to such an extent that hybridizing has been given up.

Widespread vicuña domestication may still be a thing of the future, but it must eventually come. Highland Peru and Bolivia can well afford to develop a luxury industry such as this. Once the civilized world has seen the superb qualities of vicuña wool, it will surely demand fabrics originating from this prince of wool bearers, the little Andean camel with the Golden Fleece.

▲ A LOVABLE VICUÑA ORPHAN, two weeks old, being reared on cow's milk

➤ THE VICUÑA is graceful in motion and has been seen to keep up with trains of the Southern Railroad of Peru

CLOWN FISH

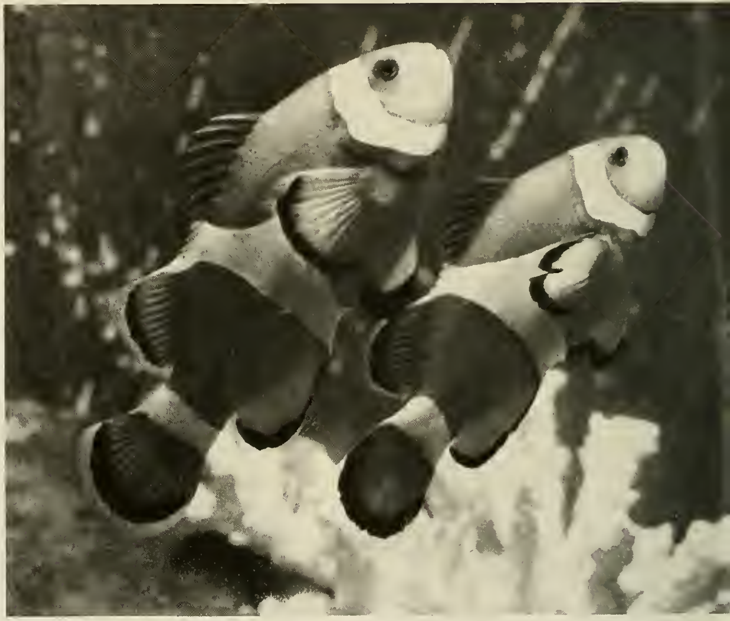
Serving as nursemaid and provider for a vicious "sea flower," this gorgeous little fish enjoys the comfort and safety of a well-armed castle

By Woody Williams

Photos by the author, courtesy Steinhart Aquarium, California Academy of Sciences, San Francisco

IT is not uncommon for an aquarist to be accused of touching up his tropical fish with a paintbrush—especially if the fish are damselfishes (Pomacentrids), such as *Amphiprion percula.* These pygmy beauties, about three inches long, are bright orange with bizarre stripes of white, and their fins are tipped with black. They come from the Indo-Australian coral reefs of the western Pacific. Because of their slow, clumsy "gait" and flamboyant color patterns they have been named "clown fish." But to the biologist they are more than comical oddities from the South Seas. As partners of the large sea anemones, they represent one of nature's most astounding examples of symbiosis—the close association of two dissimilar organisms for mutual benefit.

Symbiosis is not rare in nature, but there are few examples where the relationship seems so intimately integrated as among the damselfishes and the large sea anemones, such as *Stoichactes,* among whose tentacles they make their home.



▲ Bright orange with conspicuous white stripes, the clown fish attracts much attention in the aquarium because of its beautiful appearance. But its extraordinary habits are even more startling

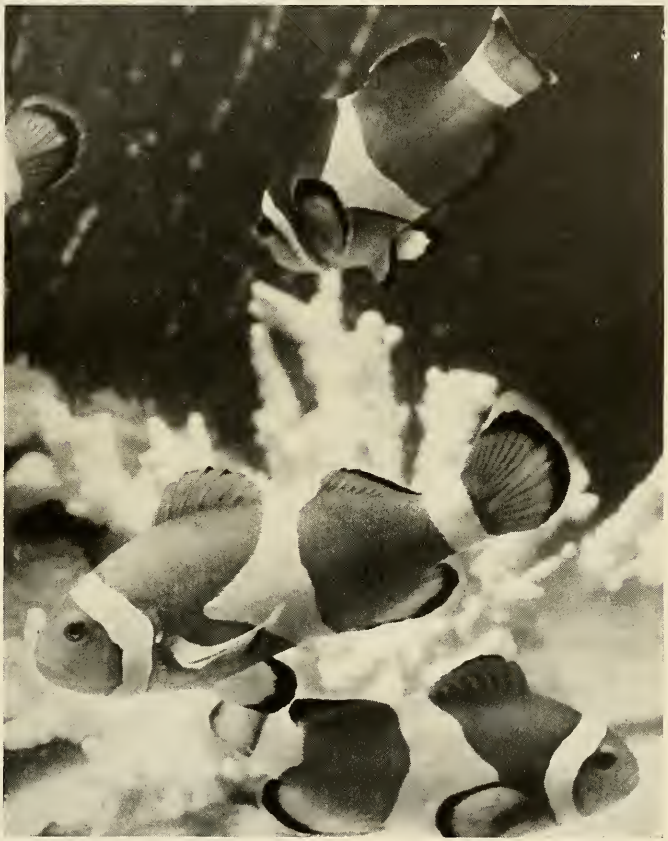
These petal-like tentacles, to all appearance as innocent as a daisy, actually possess the stinging power of a nest of hornets. Some of the tropical anemones are known to inflict painful wounds on man, to say nothing of their potency against lower creatures of the sea. The instrument that produces such effective results is a comparatively complicated one-celled structure called a nematocyst, present in countless numbers. These stinging cells eject a dart which, when it pierces the tissue of an unlucky visitor, injects a poison that often causes pain or death. Yet the damselfish nestles among these lethal tentacles with perfect safety. Indeed, the fish's very existence on the reef would be questionable if it were not able to seek refuge among the anemones without bodily harm. If deprived of its hiding place, it would become easy prey to larger forms, for it is a slow swimmer and its gaudy suit is conspicuous.

Apparently these fishes are immune to the poison of the stinging cells. But not just any anemone with an effective battery satisfies a given species of damselfish. Each kind of damselfish restricts itself to one or sometimes a few species of anemones, the choice depending probably to some extent on appropriate size. The marine biologists in Java who have studied *Amphiprion* and related forms most extensively have learned to predict which species of damselfish will be found in given types of sea anemones.

They have also found that damselfishes are primarily individualists. Once a pair of clown fish have

▲ THE HOME of the clown fish is among the tentacles of the sea anemone, which contain stinging cells that are often fatal to creatures of the sea. Yet this fish nestles here in perfect safety

▼ LIKE BEAUTY AND THE BEAST, the strange relationship between the gentle clown fish and the lethal sea anemone progresses happily —with curious benefits to both parties



established a home in an anemone (or a group of anemones), they tend to maintain the territory for themselves. However, young clown fish are sometimes found in the same anemones with adults, who perhaps did not have the persuasive power to evict the youngsters.

Some relatives of the clown fish are quite emphatic in their defense of home. This trait sometimes leads to their capture. When a diver descends near their home, they will rush out from the anemone and nip his legs, shoes, and net, thus exposing themselves to easy capture. Generally, however, the clown fish will hide in the disc of the anemone, remaining there even after the anemone is lifted from the water, and in this way they can be collected. Such a clown fish, together with its anemone, lived for years under the care of a woman in Philadelphia, according to Frederick H. Stoye, who writes on tropical aquarium fishes.

The species of *Amphiprion* shown in these photographs is believed to pair off for life. The female outdoes the male in size, and following a tendency that some think they detect in human society, she is the aggressive suitor. Nipping each other's flanks is one of the favorite courtship pastimes. The male cleans off a hard surface at the base of the anemone, and the female deposits 200 or 300 eggs. The housekeeping is done by the male. After the eggs have been laid, he rubs against the tentacles of the anemone, directing them downward so that they camouflage the eggs. This ability of the clown fish to direct the actions of the anemone is one of the most remarkable aspects of their relationship.

Many details in the later development of the young *Amphiprion* are still concealed in the mystery of reef life. However, the Netherlands scientists are quite certain that after hatching, the young swim to the surface and feed on tiny floating or weakly swimming animals. Many *Amphiprion,* in turn, are of course preyed upon by larger creatures in this combination nursery and hunting ground at the surface of the sea.

In a short time, the survivors of this vertical migration drop again to the bottom and search out anemones in which to set up housekeeping. If the anemones are scarce, several clown fish may congregate in one.

For a time, the clown fish feeds on minute bits of life captured by the tentacles of the sea anemone. But as it matures, it probably again depends primarily on floating organisms passing near its home. In captivity, *Amphiprion* appears to do well on *Artemia*, otherwise known as brine shrimp, which are collected from highly salty waters or hatched out from eggs in salt solutions in the laboratory or home. In nature, the clown fish's feeding habits are not well known

One species of damselfish is known to carry morsels of food to its anemone and place them among the tentacles. Even more astonishing is the report that a damselfish has been seen to "nurse" a sick anemone back to health by fanning it and rubbing against it, a situation that is said to occur when the sea water becomes unfavorable to the anemone's health. The anemones seem definitely to do better when accompanied by their damselfish. On the other hand, damselfish have occasionally been observed to feed on the tentacles of the anemone that shelters them, and it has been suggested that this habit builds up an immunity to the poison.

Such, in brief, is the strange partnership between these two fascinating animals that dwell together on the bottom of the sea. The average man, lacking the elaborate equipment used by the undersea explorer, can nevertheless observe their strange behavior in some of our public aquaria. One cannot fail to imagine what fascination they would hold as household pets in the home fish tank. But these are creatures of the sea, not of fresh water. Last year, two shipments of *Amphiprion* came into the United States through San Francisco, but the great losses that were suffered in transit across the Pacific caused further efforts toward importation to be dropped. So the best thing one can do is to ask whether he can see the clown fish and its strange partner the next time he visits a large city aquarium.

Anyone wishing to learn more of this strange partnership will be repaid by reading Dr. E. W. Gudger's comprehensive paper in the *Journal of the Royal Asiatic Society of Bengal* (Science), Vol. XII, 1946, No. 2.

Animals of the

High among the rock-strewn slopes, four furry alpine animals will soon emerge from their snow-bound castles to enjoy a brief season of sunshine — spring, summer, and fall crowded into one

By Tom McHugh

All photographs by the author

THE CONY, OR PIKA, makes hay while the n shines and then luxuriates beneath the now. Photographed in early July, this seven-ch animal shows only one remnant of its eavy winter coat—the light patch on its hind uarters

➤ UNDER as much as ten feet of snow, the higher slopes of the Rockies are slow to welcome summer. Protected by this blanket, the mountaineering mammals either hibernate or subsist on stored food

Avalanche

A SHORT alpine shower had temporarily slowed our pack trip on its way over a mountain pass in the Rockies. Brief yet violent, this storm spent its force in less than an hour. Clearing skies again brought quiet to the high country—but not for long . . .

Soon we were startled by a sound that began like the roar of distant thunder. Rapidly becoming louder, the din threw the area around us into turmoil. Our horses reared up in fright. Small animals scurried for shelter. At that moment we witnessed the greatest spectacle in the struggle between weather and the mountains:

Avalanche!

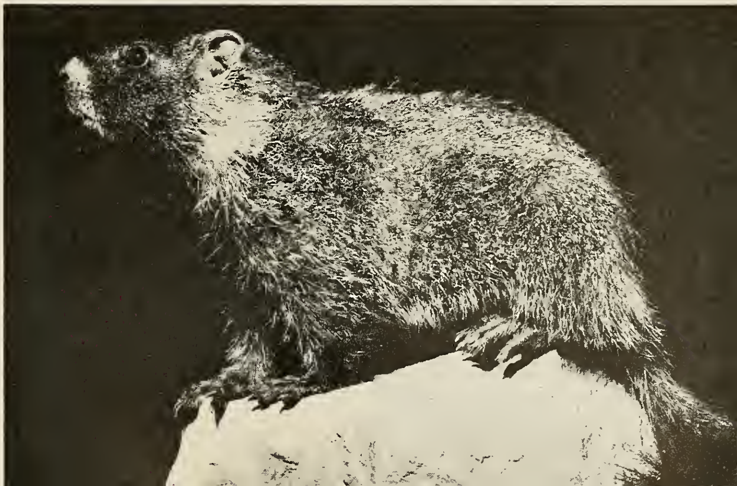
Rock jarred by the recent storm had just toppled from a high crag to start a cascade of boulders, which gathered more force by the second. This river of rolling rock poured destruction down the mountainside next to us. Like the spray from a waterfall, a cloud of stone powder rose from the grinding landslide. Small clumps of trees were snapped like matchsticks. This thunderbolt of boulders finally stopped when it hit more level ground on the valley floor below.

Then only the burned smell from the grating rocks called to mind the ruin on the slope before us. It was a picture of confusion—confusion in the tangled mass of rock and confusion in the fact that this avalanche had actually been a godsend to a group of alpine animals. Oddly enough, the rockslide had made more homes for these creatures.

Such piles of rocks or talus, as they are called by geologists, form a very secure fortress for four ingenious creatures: the pika, the marmot, the golden-mantled ground squirrel, and the bushy-tailed wood rat or pack rat. Using rock piles as secure homes, these mountaineering mammals can survive the rugged alpine life on our western snow-capped ranges.

A quick glance at the talus slopes leaves an impression of bleak desolation. "How could anything possibly live on that barren desert of rocks?" asked my companion. But he failed to look closely. Here and there in bits of soil among the boulders small plants can eke out an existence. With tiny leaves and stems, they devote most of their energy to large colorful flowers. Greenery growing in the lush mountain meadows next to the rockslides fares better, for it is usually fed

➤ A MARMOT, alert for danger atop a lookout post. Should enemies approach, he will quickly sound his alarm, and all marmots roundabout will dive into their rock castles



◀ IN ROCKSLIDES like this one, the marmot, ika, wood rat, and golden-mantled ground quirrel make their homes. You can find them ven as high as the snow fields on the distant eak from the water of countless melting snow fields.

Higher up, near timber line, the picture does become more desolate, however. Trees that are about 100 years old grow no more than waist high. They are stunted by the short growing season, the strong dry winds, and the low temperatures. As we climbed above the last remnants of these trees, other plants also became scarce. In their place, ice filled the cracks between the rocks. We were forced to wear gloves even during midday, the rocks were so cold. And the brisk alpine breeze didn't help matters. "I guess we've seen the last of any animal life," I was finally forced to remark to my friend.

But I was wrong.

As we struggled to the peak of the Grand Teton, we found tracks. Running across a large snowbank at an altitude of over 13,000 feet, they showed where a pika, or cony, had wended its way in search of food. Conies have been found even higher than this. They occur up to an elevation of 14,254 feet in the Sierra Nevada range – almost 3 miles above sea level!

Lower down, around timber line, these alpine animals make their best stand. Although their talus slopes appear bare and abandoned at first, the occupants quickly let you know that someone is home. As an intruder and potential enemy, you are greeted by a chorus of sounds. These alarm notes are the telegraph system of the rockslides.

The most unusual call sounds like "*enh*" and seems to say "*Yeah?* Mind your own business!" It has what speech teachers would call a "nasal twang." But more than anything else, it is confusing because it is difficult to localize. The sound seems to come from nowhere on the talus slide, until finally the originator moves about and reveals himself to be a pika. His head points skyward like a baying wolf, his feet shuffle, his ears twitch upward, and his shoulders move forward as if to expel more air from his lungs—and out comes another "*enh*"!

The pika's call alerts the marmots, or rock-chucks, who burst forth with a volley of sharp whistles. The whistles don't seem to be alarm notes at all. Rather, they express doubt or inquiry. Other marmots in the vicinity climb to vantage points on the rocks to see what's happening. Then, if danger really threatens, the sentinels sound the alarm call, a coughed "*keyuck*." This immediately sends all marmots to the depths of their rock castles.

The golden-mantled ground squirrels also have a language all their own, even though it isn't as obvious. Chittering buzzes, grunts, and rasping notes convey their feelings, especially during fights. Danger brings forth explosive alarm notes that sound like a whistled chirp. "*Tsp*," they proclaim, and their whole body reflects concern with a nervous tail-twitch. Other squirrels in the area hear the call and come to attention, standing up on their hind feet and clasping their front paws together. It is the very picture of a minister in the pulpit ready to give a sermon.

▲ THE GOLDEN-MANTLED GROUND SQUIRREL is the most colorful of these alpine animals. The bright rufous color of the head thins out down the back but appears again in the tail

▼ THE WEASEL—probably a more serious enemy than the foxes, wolves, bobcats, and other larger creatures that prey on the little animals of the avalanche

Even though wood rats come out only at night, they also have a telegraph system. When danger draws near, a hind foot or the end of their tail rapidly vibrates on the ground. As the first rat thumps out an alarm signal, other rats within thumping distance pick up the message and relay it to still others within hearing. All animals are then on the alert to escape if enemies should come their way.

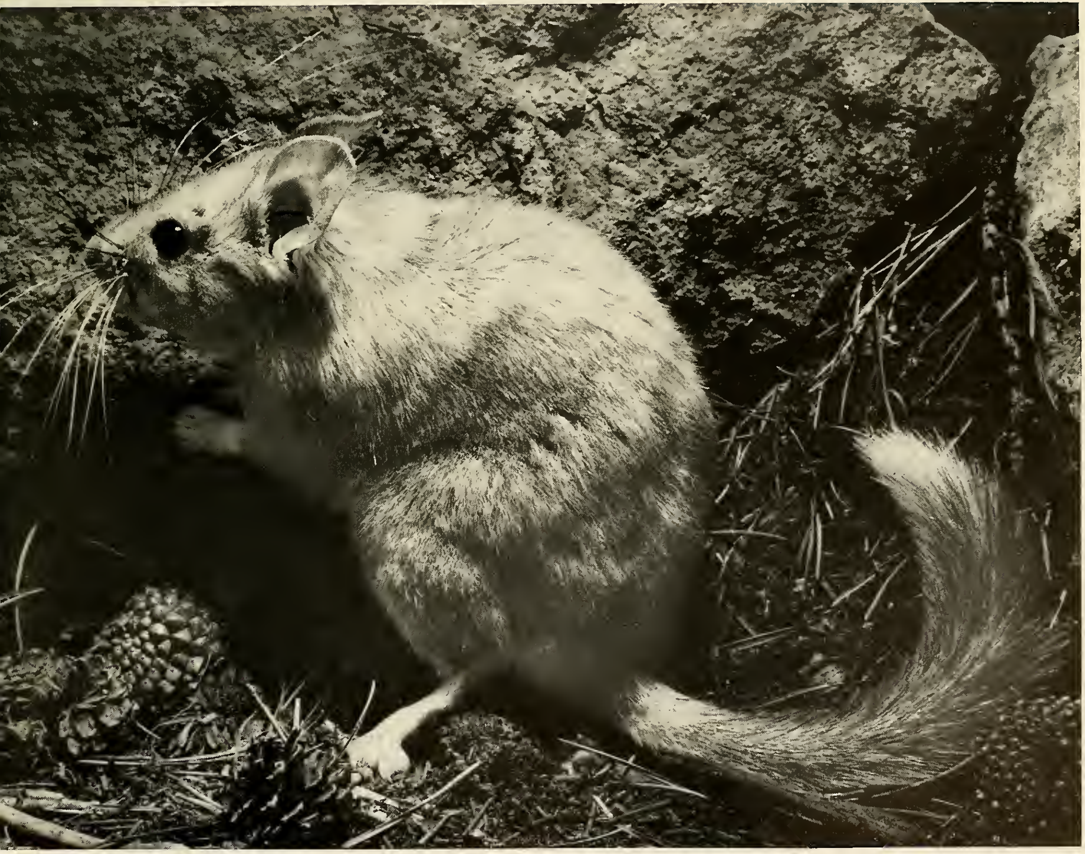
Wood rats also leave messages in another unusual way. A special gland below the tail produces a strong musky scent, and wherever the rats go, they may leave a bit of this odor to mark the place. It may serve to label the territory of one rat and warn other individuals to keep off, and it may also help indicate trails so that they may be easily followed on dark nights.

Different as are the ways of life of these four mountaineering mammals, and different as are their alarm calls, these creatures are still one family. They may depend on each other to give an alarm note. More than that, though, they are one family because they all live in the most secure home in the mountains, the grottoes of the talus slides. And they realize the protection given by their rock castles.

Although conies will travel some distance among the rocks for food, they seldom venture far beyond these rock boundaries. When not busy finding food, they like to sit

▲ AN ENEMY of the denizens of the rock-slides: a young red fox whose mother had just killed a marmot

▼ WITH HIS BIG EARS, fluffy fur, and bushy tail, the wood rat is a captivating member of the alpine quartet and need never be confused with the house rat. It has been known to collect almost everything from mousetraps to false teeth



on some prominent boulder where they have a wide view of the whole slope. This is the crow's-nest of their rock fortress. When a golden eagle —or some other enemy "plane"— circles near, their air raid sirens go into action. A series of rapidly repeated "*enh's*" broadcasts the warning, and then they tumble back into the rocks—a veritable bomb shelter.

Conies live all over the rockslides, but marmots prefer to build their den in a group of rocks near more vegetation. Here they cleverly locate their burrow between two boulders so that there is just enough room for a marmot to pass through. The tunnel is small enough to keep out larger enemies like wolves and coyotes.

While one marmot keeps a lookout on top of the rock pile, others from the den bound along like little pigs into the mountain meadows. Well-marked trails lead from the rocks to the feeding grounds in the flowered fields. If the distance is several hundred feet, a temporary burrow may be placed at the halfway point. This will serve for momentary protection until the danger is gone or until they can make a rush for the home den.

Golden-mantled ground squirrels, or "callos" as they are called for short, make their homes under the rocks near the bordering woods. They shun the deep shade of dense forests, however. Home is a little hole in the ground two or more inches in diameter and under the rocks.

There the young are born in spring or early summer. Once large enough, they emerge and romp in the sun near the burrow. When danger threatens, their mother rushes back and pushes them down into the hole with her forepaws, but innocent of the enemies in the upperworld, they rapidly pop out again when mother goes away. When bothered by too many people, I have seen a much disturbed mother pick up the young in her teeth and move them to a safer burrow.

The bushy-tailed wood rat builds his home in crevices in the rocks or in near-by cabins. The home provides protection and serves as a nursery and as a storage place for food. Above all, however, it is a "museum," for the wood rat is an industrious curio collector. Nothing escapes his eye as he packs in bric-a-brac for his nest, which may grow to include several bushels of junk.

Nests have contained such things as old shotgun shells, mousetraps, washbasins, silk socks, bright neckties, candles, soap, dynamite sticks, hen's eggs, and a clipping on forest-fire prevention. One nest contained a bushel of trash, all of which was metal. There was even an alarm clock in the pile.

People who have camped near pack rats in the mountains have had many articles of food disappear each night. Sometimes several rats participate in a raid so that larger items can be hauled off. For example, several rats banded together to roll, push, and drag a large jelly roll out of one tent.

It is hard to say how many fine friendships have been broken by pack rats. One inexperienced camper placed his false teeth beside his sleeping bag when he turned in for the night. When the teeth were gone the next morning, he blamed the guide and gave a heated lecture about practical jokes. The lecture subsided, however, when the guide located the missing teeth amid the loot in a pack-rat nest. The activities of wood rats produced even tenser moments in pioneer days. Cartridges disappeared very mysteriously in dangerous country, leading to no end of dark suspicions and perhaps even tragedy.

Sometimes the rats develop a streak of mischief that might be humorous if they were not so persistent. One little beast continually centered his efforts on the wood-box in an old shack. Each night he would drag the wood out onto the floor and place the pieces in neat rows. This was repeated many times.

Wood rats are also known as trade rats because of their habit of stealing something and then leaving a stick or other worthless object in its place. Many old-timers used to think this trait quite clever and cunning. They thought the pack rat had two reasons for trading: the theft would very likely go undiscovered if the rat substituted another piece of junk; and besides, it showed that trade rats were basically very honest, since they exchanged rather than stole articles.

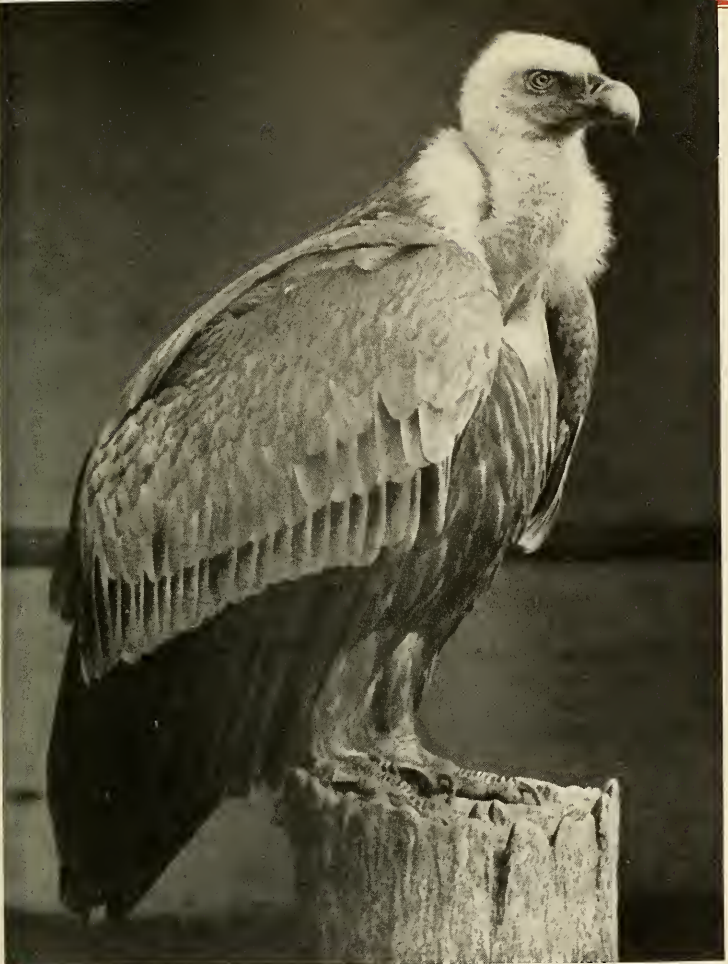
All this, of course, is sheer foolishness. The pack rat is often carrying a bit of trash for his pile when he chances across an object of even greater esteem. In his greed, he merely drops the first object and picks up the new item. Thus the "trading" habit.

With a home deep in the rock fortress, wood rat, pika, marmot, and callo are safe from most enemies. But some of these mountaineering mammals still fall prey to bobcats, foxes, coyotes, wolves, weasels, martens, hawks, owls, and eagles. The young are especially vulnerable when they innocently wander from the protection of the rocks.

Although wolves or coyotes cannot fit into the average marmot den, they still may catch a marmot out in the open meadows. Sometimes they stealthily stalk their prey and then suddenly pounce and seize it in a strangling jawhold.

Many weasels live in the rockslides and are probably the most important enemy of the pika. Although they can thread through the thin passages between the rocks as fast as the conies, they are sometimes outwitted. As soon as a weasel enters pikaland he is greeted with a barrage of alarm calls; and when he starts pursuit of a choice bit of food, he is indeed in for a race. He dodges in and out among the rocks with unbelievable speed and follows the winding course of the cony with ease and accuracy. The safety of the pika depends on its ability to dodge and outwit the enemy, but the pika soon begins to tire. As the gap between cony and weasel narrows dangerously, another fresh and rested pika leaves its lookout station and cuts into the race ahead of the weasel and just behind the first contestant, who quickly dodges out of the race. When this trick is repeated two or even three times, the weasel shows marked signs of fatigue and gives up the unequal contest.

Continued on page 240



A study in feather arrangement

The Griffon Vulture

By James P. Chapin

Research Associate in African Ornithology, American Museum of Natural History

THE Griffon Vulture (*Gyps fulvus*) is a great soaring bird of the Mediterranean Basin and eastward to central Asia. Because its meals (carrion) must necessarily be few and irregular, it is most economical of energy. Its wings are a model of efficiency. This excellent photograph by John Marinus of Antwerp, Belgium, might be called a lesson in pterylography, the scientific delimitation of feather-producing areas on a bird's skin. You will notice that the black secondaries (the quills of the forearm) are shown in a long regular row at the bottom, where they hide the primaries (the quills of the hand). Next comes the long row of greater secondary coverts. Above them is the row of middle coverts, and above that the great area of lesser coverts, in many rows. Above the wing can be seen the long scapular tract.

A wing like the griffon vulture's is a marvel of aeronautic construction, another of the innumerable examples of natural design to be seen everywhere about us. Anyone who studies birds must be impressed by the way in which almost every feather of any size is of a special shape and structure to serve a definite purpose at its particular location.

One striking feature of the whole plumage of almost every flying bird is the streamlining. Most birds are streamlined right up to the beak. The vultures, however, are exceptional in regard to the head and neck, and the reason is readily seen. If their heads and necks were well feathered like those of their near relatives the eagles, they would have much more difficulty getting their beaks and heads through openings in the tough skin of large, dead mammals to tear out the flesh and viscera on which they feed. The feathering is reduced to a downy cover that permits far greater efficiency in feeding.

A vulture may be called disgusting, but at times it is also majestic. It has its definite place in the economy of nature and usually receives equal protection by law with the songbirds. It is endowed with keen eyesight, most efficient wings, low fuel consumption, and retractable landing gear. It is a worthy member of nature's Department of Sanitation.

The First Ascen

The gripping story of how a band
of scientific explorers forced the
Flaming Terror of the Andes to yield its secrets

PART I

By ROBERT THOMAS MOORE

Associate in Vertebrate Zoology
California Institute of Technology

All photographs by the Moore Expedition

WHEN Edward Whymper in 1880 paused in his descent from the first conquest of Mt. Chimborazo, the giant of the Ecuadorian Andes, he caught sight of a formidable volcano 50 miles to the southeast. The blasé conqueror of the Matterhorn was amazed at the outburst taking place before his eyes. He made drawings of the eruptions, which he presumed were "outrushes of steam," and calculated their velocity to be "twenty-two miles per minute!" Whymper undoubtedly witnessed the early stages of a major eruption, which takes place at periodic intervals ranging from five to fifty years. A decade later, when writing his great classic, *Travels Amongst the Great Andes of the Equator,* he expressed astonishment that a volcano so formidable should be known to Ecuadorians "only by name." Whymper did not seem to know that 34 years earlier Villavicencio had called El Sangay the "most frightful volcano in the World." Nor did his book reveal acquaintance with the observations of non-Ecuadorian scientists and explorers who, for two centuries, had borne testimony to its devastating power.

The first written account of El Sangay is a partially burned document dated November 3, 1628, recently discovered in Ecuador.[1] It describes an eruption of about one month earlier, when the mountain is said to have "burst asunder," "terrorizing" the city of Riobamba 30 miles away and so covering it with ash that its cattle were dying and its inhabitants in dire danger of being destroyed. The next historic reference seems to be that of 1739, when Monsieur de la Condamine witnessed from the paramo of Zula a violent eruption that seemed "to set on fire the whole mountain and its crater," while a "burning river of sulphur and bitumen took its course in the midst of the snowy slopes." An amazing testimony to its energy was given by the geologist Reiss, when he stated that for four years without intermission a stream of incandescent lava flowed from the western shoulder of the

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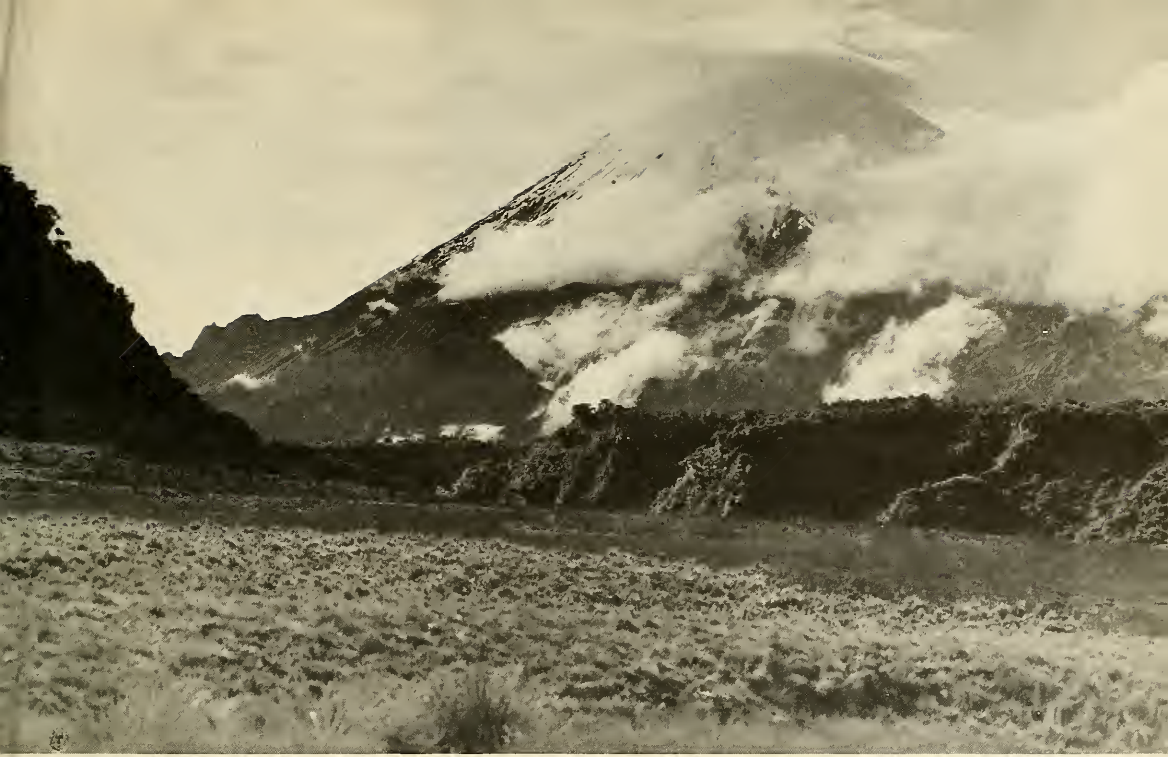
[1] See "El Sangay, Fire-breathing Giant of the Andes" by G. Edward Lewis, *National Geographic* Magazine, January 1950, p. 133, which gives an account of the last unsuccessful attempt to reach the summit.

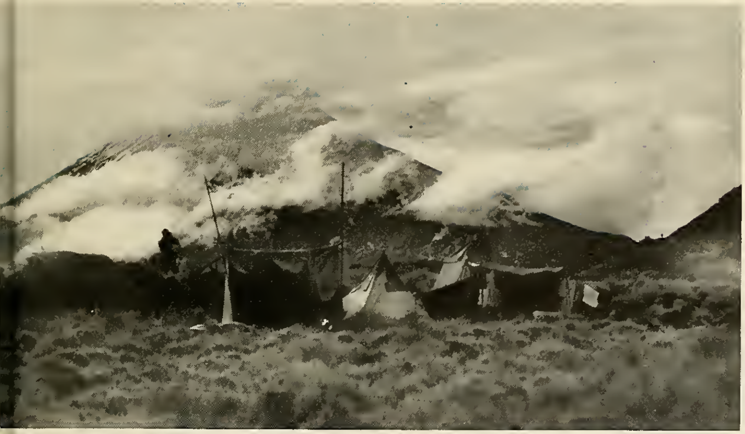
▼ WHEN CLIMBING out of the tropics, the zoologists leave large trees like these behind at the 10,000-foot level when yet 25 miles from the devastating volcanic cone. Temperate-zone vegetation in the high Valley of Alao, Ecuador

▲ INDIAN PORTERS wending their way upward with the expedition's cargo in the Valley of the Rio Alao



▲ Just behind this black wall of lava the Labyrinth begins. Huge ash canyons, 500 to 2000 feet deep, extend for 15 miles from here to the base of the volcano

# of El Sangay

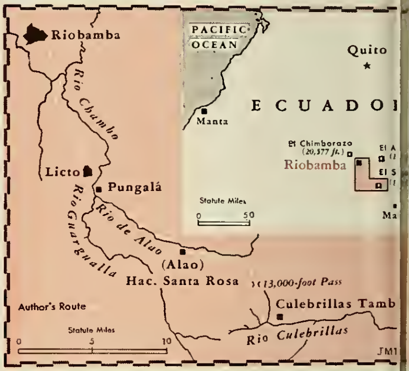


▲ "The Shroud parted for a moment, and there, 70 degrees east of south, El Sangay towered above the labyrinth of canyons." The peak is still many miles away, and a network of huge gorges lies between. To save time, the expedition ascended a 14,000-foot mountain range to the right to reach a knife-edge ridge before plunging into the Labyrinth

volcano. In 1849, the engineer Wisse expressed astonishment mathematically by counting 267 loud explosions in an hour.

Many observers have noted that the roarings of the volcano have been heard in Guayaquil, 110 miles across the Andes, and sea captains far out on the Pacific have seen the decks of their vessels drifted with its ashes. So great is the mass ejected, Reclus assures us, that it would equal that of several mountains. "It seems probable," adds Dr. A. H. Mozans, "that the disastrous earthquake which destroyed the old city of Riobamba in 1797 had its origin in El Sangay. So complete and sudden was this visitation that few of the twenty thousand inhabitants were able to escape." And then come the fables and legends that always cling to the skirts of terrifying phenomena. "Everyone

◄ Near Tres Aguas. Here, among the overhanging grasses of the riverbank, the expedition discovered the first known nests of the Black-throated Bronze-tailed Hummingbird. Like all of the more than 600 other species and subspecies of hummingbirds, it lays two pure white eggs. Tracks of the rare Mountain Tapir marked the muddy approaches to the stream



had heard of the 'Flaming Terror to the east of the Andes,'" said Commander Dyott, "but no one had ever ventured near it. Within several leagues of its base (so ran the tale) were lakes whose water spouted high in the air, drenching the country for miles around and forming a sort of water barrage." And even the renowned Humboldt did not dissolve this atmosphere of superstition by describing a fish, "*Pimelodus cyclopum,*" which he says was thrown out in great numbers during minor eruptions of Cotopaxi, Tungurahua, and Sangay!

I have not space to quote from Wolf, Stübel, Hans Meyer, Stevenson, and many others who have observed the demonstrations of El Sangay. A final quotation from the *El Telegrafo* of Guayaquil will suffice: "Alfonso Stübel . . . initiated an attempt to creep up on the shoulders of the colossus in April of 1872, but he, like G. M. Dyott, the intrepid Andean explorer, abandoned the enterprise, their audacity punished by the imminence of destruction."

There seems to be no record that anyone actually crossed the snow line until November, 1925, when Commander Dyott, after months of effort, came to grips with the ice field.[2] On his first attempt he was struck down with snow blindness, and on his second he fell into a crevasse on the southern shoulder, while his companion was incapacitated by mountain sickness. Both finally abandoned the effort. *El Telegrafo* concludes, "El Sangay continued to guard its mystery inviolate—a mystery vast and sublime!"

As I survey this strange admixture of science and superstition, I do not wonder why so many efforts have been abandoned at the far-flung boundaries of El Sangay's demesne. I confess I was affected. No doubt it influenced my statement to members of the party, "This first attempt is purely a zoological reconnaissance to Culebrillas Valley, only three days' journey! There is not one chance in fifty I shall give permission for an assault on El Sangay." And yet I did!

Mysterious as it all seemed, one thing was clear—the terrain would prove a difficult problem. Detached from the main chain of the eastern Andes, El Sangay juts out over the Amazon basin, a lonely sentinel nearly 18,000 feet in altitude. Although only 125 miles south of the equator, its last half mile of altitude is crowned with ice. At its eastern base begins the tropical forest which stretches without break 3000 miles to the Atlantic. So impenetrable are the jungles of the steep eastern slope that no one has attacked the summit from this direction. On the other three sides, 1000 square miles of volcanic ash have been sculptured by almost constant rains into a labyrinth of black canyons 500 to 2000 feet deep. Down each one swirls an angry torrent—the whole constituting a veritable maze, whose intricacies have never been deeply penetrated by the superstitious Indians living about its margins. They never cross its borders save for an occasional forage among the rare animals, which here have made their last stand in a sanctuary created by superstition. Above and about it all hangs a shroud of mist and cloud, lifted but for brief intervals.

In addition to difficult terrain, severe weather conditions, and the possibility of a major eruption, the superstitious fears of the native cargo bearers constitute an even more serious impediment to would-be conquerors of El Sangay. Favored by no trails to slip through the tough undergrowth and surmount the great ranges, one must rely upon these natives to carry most of the supplies and equipment required for a month's struggle with unexplored regions. They believe that a frightful god lurks in the crater, who waits for them to enter the canyons and drowns them with floods of water and ice. Terrified by the frequent earth-vibrations emanating from the great volcano, they are ready to forsake the explorer the moment the peak appears through a rift of the shroud. Three times our party was abandoned by different groups or individuals, the mass desertion at Tres Aguas threatening disaster. With tents leaking, ammunition and food supplies wet, and fires refusing to catch flame, the party was in real danger, either of being washed out by rains or weakened by lack of food. Fortunate kills of deer and tapir relieved the tension.

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[2] See "The Volcanoes of Ecuador" by G. M. Dyott, *National Geographic* Magazine, Jan., 1929; also his book *On the Trail of the Unknown.*

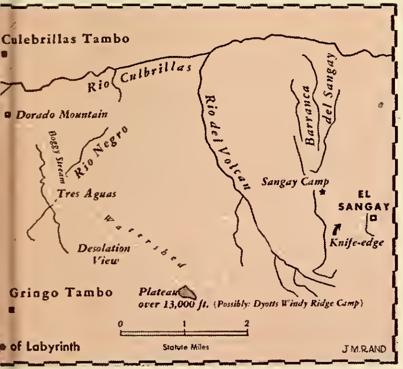
On July 15, the party, consisting of Lewis Thorne of Yale University, my son Terris Moore[3] of Williams College, Waddell Austin of the University of California, and three Quechua zoological collectors, with myself as leader, motored out of Riobamba, Ecuador. We soon found ourselves in a public square of the Indian village of Licto. Here our genial host, Señor Alphonse Merino, on whose courtesies and thoughtfulness the success of our enterprise largely depended, introduced us to our caravan of eight horses and ten pack mules. After the usual delay (according to approved Ecuadorian style), we mounted and shot through space like arrows loosed from a bow, and for three hours we careened along the Rio Alao at the same mad pace, whether the course clung to the brink of gorges, or dropped down descents strewn with boulders, or slipped through cascades loosed from the mountain above.

At Hacienda Santa Rosa, which we called "Alao" after the river, Señor Merino had a surprise for us. Through the motley mass of peons in the courtyard we were escorted into a bedroom furnished in the style of Louis XV! The leader of the party was only too glad to accept the offer of the gilded bed, for he had risen that morning with a temperature of 103 degrees. The rest of the party were shown the premises. Señor Merino explained his plans for gardens and fountains to be modeled after a famous French chateau. Electric fixtures and water pipes had been installed, although not yet functioning, and a library revealed interesting titles in Spanish and English. The buildings were the center of a ranch whose borders stretched in a vague way from the ice fields of El Altar to the affluents of the Amazon. Over this vast demesne our host reigned, a medieval lord with a retinue of peons at command. They could not leave his property without consent. His approval was asked for marriages, and punishments for misdeeds were assessed by him as judge. He had the right to use the lash.

Somewhere in this realm rose El Sangay, but the owner had never seen it, and his brother Miguel, who had, was now dead. Yes, he knew of Señor Dyott's attempt to reach the summit. Two of the peons who had gone part way with him were left; one of them—Vinci—would be our guide. "But," he added emphatically, "this is a bad time of the year to try El Sangay—the very worst! It rains every day for months! The Indians fear the rising streams!"

Nevertheless, the following morning our equipment of tents and blankets, guns and traps, cameras, color plates and films, and all the paraphernalia for mountain ascents (ice tent and optimus stove—even snowshoes and an ice ax) were packed on the backs of eleven Indians, and off they dog-trotted up the valley. Flowers were grouped in great clumps along the stream that leaped from rock to rock. Calceolarias proffered clusters of golden slippers, Taxcus climbed here and there through the thick growth, their great pink trumpets nodding overhead. Large patches of the orange parasite called "Picapus" brought beauty to the treetops and lured the Sunbeams—hummingbirds, *Aglaeactis cupripennis cupripennis* Bourcier, with a veritable sunset on their backs. But the glory of the valley was the fuchsia. The superb scarlet bells hung in every conceivable line of grace and tempted hummingbirds of many species to explore their chalices. On all this loveliness of flower and dashing water, a tropical sun shone with a balmy intensity found only in favored Andean valleys.

But beauty and sunlight had to be



➤ **On the edge** of a 2000-foot cliff, the newly recruited Indians are transporting the expedition along the knife-edge between Tres Aguas and Carniceria. The knife-edge has begun to widen out, and the Indians are gazing into the vast maze of ash canyons, only a small portion of which can be seen here

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[3] Subsequently Terris Moore made the first ascents of Mt. Bona and Mt. Fairweather in Alaska and still later of the 24,900-foot Minya Konka of western China.

◀ THE MARGIN of the plateau called Carniceria ("Meat Market") by the Indians. The paja grass, with rapier-like edges, grew five to eight feet tall in the center of the plateau. Herran's Thorn-bill flitted among the flowers of the pear-like tree—its fiery throat a fit symbol of the mighty volcano

left behind when we began the steep ascent of the southern rim of the valley. For a while sunlit glimpses of Alao could be caught through heavy tree growth clinging to the lower walls, but shortly thereafter we reached the wind-swept paramo and under the wings of inquisitive condors began our long trek beneath the pall of cloud and mist, which we came to call "The Shroud of Sangay." From this time on, rain fell every day for the next 26, with only occasional parting of cloud masses. Sometimes it drenched us with sudden outbursts, sometimes it swathed us in chill mist, but for the most part it contented itself with a monotonous drip, drip, drip—day after day—that gradually sapped ambition and made memory of sunnier hours seem like dim-remembered childish pleasures. When sunlight finally came, all semblance of a trail had disappeared. Our first camp was pitched at the top of a high pass to the accompaniment of bleak winds and the howling of many dogs. The Indians insisted on taking these ravenous creatures to help in hunting tapir and deer.

For several days we followed the general course pursued by Commander Dyott over three mountain ranges. Because of deserting Indians and other difficulties, few days registered progress. Throughout this period we occasionally happened on machete marks on shrub or tree, where Dyott may have passed. After the thirteenth day we descended into deep canyons and never came across any marks again. It is impossible within the limits of this article to tell the many incidents and near-disasters of these difficult days. Kaleidoscopic views are the best I can attempt.

Toward the end of a day of constant climbing, we reached the top of a pass 13,000 feet above the sea. The wind howled through the gap at a temperature close to freezing and drove us down the opposite slope for protection. Trails there were none, except the bed of a stream. For hours we stumbled and slipped over hummocks of *paja* grass, forever stubbing our toes and dropping into concealed gullies. We were thoroughly soaked. Wading the icy torrent seemed preferable to the pounding that toes and ankles were taking. The earth assumed the consistency of a supercharged sponge. We forded many streams. As the light darkened and the billowing Shroud sagged into the valley, we located the remains of Commander Dyott's camp site at Culebrillas. We pitched our tents in the driest spot of a huge morass that filled the entire floor of the valley. That same night fortune favored us. The Shroud parted for a moment, and there, 70 degrees east of south, El Sangay towered above the labyrinth of canyons. Incredibly high it stood against the southern sky, ghostly and wan in a flood of moonlight. It seemed to fill the whole end of the valley, and yet it must have been many miles away. But distance conveyed no feeling of safety when that night a severe earthquake brought us to our feet!

We had now reached the margin of the tangled mass of canyons. The front of a lava flow faced us. Our valley ran approximately southeast directly toward El Sangay, and not far away in that direction began the intricate system of water-sculptured chasms, which we termed the "Labyrinth." If we wanted to proceed into it, a route straight down the valley would mean nothing but an endless crossing of canyon after canyon. The valley wall on the southern side headed in the desired direction. We named it Dorado Mountain for the rare hummingbird we found there. It was decided that Lewis and Terris should follow the top of its ridge in order to ascertain whether it continued for any distance and might afford easier access to El Sangay.

Here Vinci, the leader of the peons, refused to go with them. He claimed rheumatism! We suspected cowardice. He even refused to let his peons advance without him, exclaiming, "There are no trails! We have to cut through with machetes!" A threat of punishment from his master, Señor Merino, brought him to terms. His sullen look as he left indicated no desire to co-operate.

As we watched the boys lightly plunge up to their waists into the Rio Culebrillas, the rest of us gave attention to the exploration of Culebrillas Valley. No zoologist had ever set foot in it, let alone entered the Labyrinth. The entire floor, 11,000 feet in altitude, consisted of a vast water-soaked swamp of paja, ex-

➤ A DOZEN PHOTOGRAPHS would be necessary to give a complete panorama of the Labyrinth from Desolation View. The entire area was once a huge plateau of black ash vomited out of El Sangay. Now it is sculptured into a network of gorges

cept at the southeast end, where it was broken by the black front of a lava flow that had its origin in El Sangay. A stunted tree growth covered the lower slopes of the mountain walls, and their gnarled condition reflected the severe climate. Small waterfalls dropped here and there, attracting a few insects which, in turn, lured five kinds of hummingbirds to the valley. All told, eight species of these iridescent creatures were found in the larger Sangay area, an astonishing number in view of its barren volcanic nature, relieved only by grass and stunted trees and practically barren of flowers.

The most conspicuous hummingbird was the huge Sapphirewing, *Pterophanes cyanopterus cyanopterus* (Fraser), whose ultramarine wings flashed back and forth through the sunlit spray of the waterfalls. It created a lasting memory of color and grace in motion. Gay's Velvetbreast, *Lafresnaya lafresnaya saül* (Bourcier & Mulsant), with its glittering black apron, fed from the orange corollas of a parasite, which festooned the moss-covered trees. The most persistent sound was the loud call of the Mountain Ant Thrush, *Grallaria monticola* Lafresnaye. Heard, but seldom seen, this bird dashed about the boggy runways. When calling, it stretched its stiltlike legs to full limit and then collapsed like a jack-in-the-box.

The most conspicuous sight in the valley were the hurtling forms of Noble Snipe, *Capella nobilis* Sclater, closely resembling our own Wilson. At twilight the ecstatic gyrations of the rarer Jameson's Snipe, *Chubbia jamesoni* (Bonaparte), whirled overhead to the accompaniment of strange sounds like a policeman's rattle of varying pitches. There were Tinamous on the paramos, Spur-winged Ducks in the streams and Red-backed Buteos[4] on the dead trees, occasionally tearing a rabbit to pieces for a clamoring youngster.

But our supreme moment of scientific excitement came with the songs of Tanagers. At the southeastern end of the valley, the Rio Culebrillas wound across to the north side along the lava flow and cut its way through to the first deep canyon of the Labyrinth. Here tree growth was heavier. Singing in the treetops was an extremely beautiful bird, brilliant in green, yellow, blue, and black. It proved to be an undescribed race of the Blue-rumped Mountain Tanager, *Buthraupis eximia cyanocalyptra Moore.* Still more startling was the discovery of a golden tanager with sky-blue wing marks, so different from all other tanagers that a new genus had to be created for it by the author. He subsequently gave to the American Museum one of the only three known specimens of this bird, *Tephrophilus wetmorei* Moore.

In other ways we were well rewarded, in spite of continuous rains. We secured many small mammals and 223 birdskins, discovered the nests new to science of several species, procured the second specimen in existence of a rare white-tailed deer, and found in the heart of the Labyrinth the unknown home of the nearly extinct Mountain Tapir.

On the third day, Terris and Lewis returned with an alluring account of the volcano that stood stark and gaunt on the skeletonic ribs of the Labyrinth and of a lofty watershed bisecting it, which proffered an opportunity to climb over its canyons. But while we discussed the possibilities, we were faced with a serious loss in personnel. Old Carlos Olalla, for 40 years triumphant victor over the wildernesses of Ecuador, had to admit defeat. Without his sage counsel and ability to understand and control the waywardness of the Alao aborigines, we would be badly handicapped.

On the following day, leaving all heavy equipment with Carlos at Culebrillas, the main party crossed Mt. Dorado to the south at an approximate elevation of 14,000 feet, laboriously cutting a way through the gnarled tree growth, and plunged into the wilderness on the other side of the range. My notes remark: We followed a stream down its boggy course, slipping in countless mudholes. Late in the afternoon we reached the junction of three rivers completely "bogged," as the boys expressed it. A mile from our camping place we passed by the water-soaked cliff where Terris on the reconnaissance had discovered the first recorded nest of the Fiery-throated Hummingbird, *Chalcostig-*

Continued on page 238

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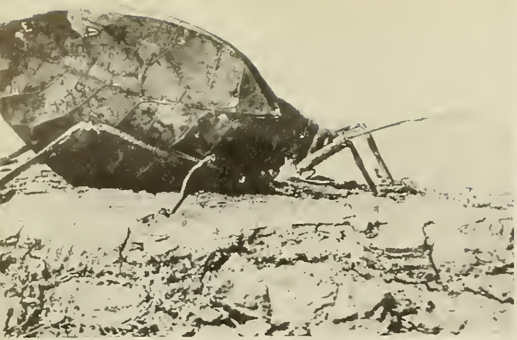
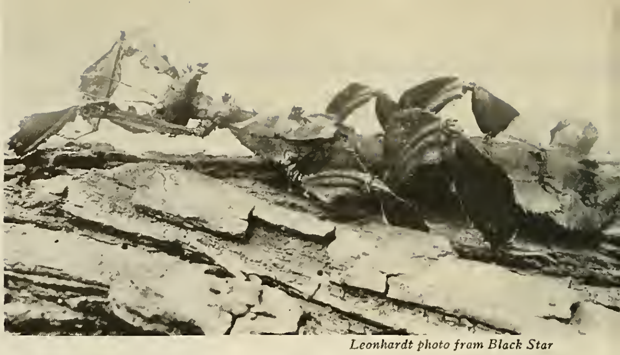
[4] *Nothoprocta curvirostris* Scl. & Salv., *Merganetta armata leucogenis* (Tschudi), and *Buteo polyosoma polyosoma* (Quoy and Gaim).



Leonhardt photo from Black Star

▲ ANIMAL OR VEGETABLE? Not a tobacco leaf with legs and feelers but a South African long-horned grasshopper, *Cycloptera camillifolia,* neatly camouflaged from preying birds and reptiles



Leonhardt photo from Black Star

▲ IS THIS a withered twig stuck against the bark? Its odd-shaped thorny "leaves" blend with the background, but it is one of the insects known as the phasmids, *Extatosoma tiaratum.* It is found (by those whose eyes are sharp enough to see it) in New Guinea and Australia

HOAX or Fair Warning

Many unarmed creatures have bought security the cheap way—masquerading as animals that are dangerous or as unattractive parts of their natural background

By LORUS J. and MARGERY J. MILNE

EVERY summer, by way of showing a few outdoorsmen the importance of a wide familiarity with animals, we point to a golden-brown insect hovering over a flower or busily seeking nectar within the blossom, and ask: "What is it?"

Our friends look at us with amazement. How can we be so ignorant? "A bee!" they almost shout.

We prod it with a finger, and it buzzes but keeps on feeding. "Don't do that. You'll get stung!" someone is sure to warn us.

By way of answer, we swoop down on the insect with open palm and snatch it from the flower into a clenched fist. Instantly the buzz rises to an angry whine. While our friends watch apprehensively, we reach in with thumb and forefinger and casually pluck out the struggler by its wings. The insect's abdomen prods around toward us as though ready to drive home a vicious sting. But nothing happens. The "bee" is a fly—the Drone Fly—an impostor that has fooled many people, as well as millions of hungry birds. It is completely defenseless but so like a honeybee in shape, size, color, and antics that a practiced eye is needed to detect the difference.

Nature is full of pretenders. Wherever we and the other animals learn by experience to expect one situation, some few creatures profit by our expectation and thereby prolong their own lives. Some creatures are strong, well armed, and ready to resist attack. Others, lacking such advantages, escape because they *seem* to be what they are not. Imitators of this sort are common all around us, but care is required to hunt them out.

A wide variety of animals evade notice because they resemble plant parts. Creeping over seaweed are shell-less snails, camouflaged by all manner of waving, leaflike appendages in a great range of colors. They are known as Nudibranchs, and they often miss detection because the gentle waving of their decorations, in time with strands of seaweed, conceals their leisurely progress from place to place. Sargasso Fish are equally difficult to recognize in their tropical and subtropical waters because of their simulation of seaweed.

Among land animals, the insects are the chief imitators of vegetation. Almost everyone has heard of the Leaf Butterfly of India (*Kallima*), in which the closed wings resemble a leaf, complete with midrib, short petiole, and some indications of branching veins. In temperate America we have other butterflies that suggest leaves, but our kinds all possess what appear to be tattered edges, as though the leaf were not only a dead one but had been lacerated by wind and winter. Several of these ragged-wing butterflies follow a seasonal cycle that gives their resemblance to dried leaves more than coincidental significance and more than incidental value. They are active chiefly in late autumn and early spring, when green leaves are rare. They have only to cling to a branch and close their wings to disappear. In winter, they conceal themselves as adults under bark or in crevices.

A bare stick may attract even less attention than a ragged leaf. Resting among twigs, our native Stick Insects are almost perfectly concealed, and their movements when undisturbed are so slow that the illusion is seldom destroyed. Nor do most of them descend to the ground to lay their eggs. Instead they drop them, like so many radish seeds, to bounce from leaf to leaf. They patter like rain when the insects themselves are numerous, to lie among the fallen foliage through the winter. In the spring, each pale-green stick insect emerges by a private trap door in its seedlike egg.

In the tropics, stick insects grow to larger sizes, and many of them are winged. Some have leaflike extensions on legs and body that look like the remains of foliage after an army of caterpillars has hurried through. Grasshoppers, too (particularly the long-horned kinds related to our katydids), show comparable diversity. Removed from their leafy homes, these green insects are seen to be ornamented by the most fanciful projections, as though each were but a caricature of a grasshopper. They are as unnecessarily decorated as a billboard embellished by crayon-wielding small boys; but Nature has not burdened them with useless impediments. These decorations help the insect to survive by blending the leaflike body with the tropical foliage.

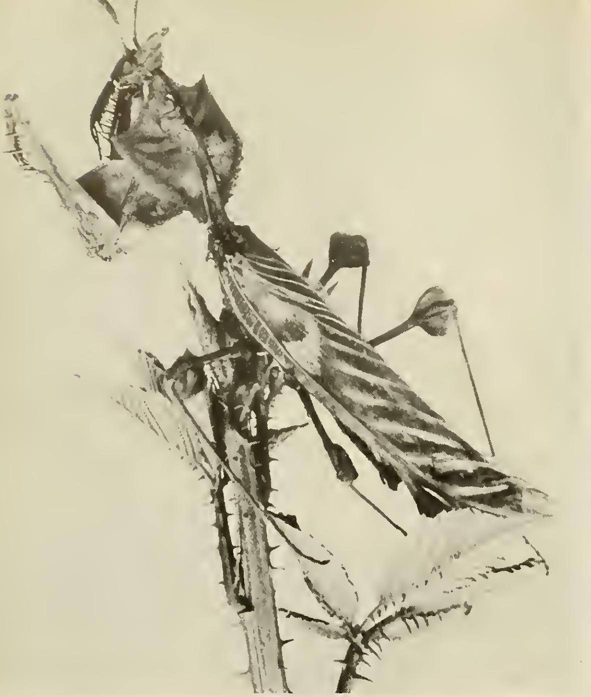
A STICK INSECT has a silhouette like a oup of twigs. As long as it moves slowly, may easily be passed unnoticed

Photo by Lorus J. and Margery J. Milne

Photo by Lorus J. and Margery J. Milne

▲ THE PRAYING MANTIS matches foliage so well that it easily ambushes flies, moths, and caterpillars

Similarity to plant parts can also help the hunter as well as the hunted. Praying Mantises of many kinds wait hidden by the leaves, among which they stand motionless or sway gently from side to side as though tossed by a slight breeze. Such deception in the tropics may be augmented by tattered appendages of leafy green. Then along comes a fly, a beetle, or a caterpillar. The mantis' triangular head turns big eyes toward the prospective victim. Suddenly the folded forelegs extend from concealment



Leonhardt photo from Black Star

▲ APTLY NAMED the "Devil's-Flower," this mantis of Africa conceals itself effectively among the vegetation and is a hidden trap for other insects. (*Idolum diabolicum*)

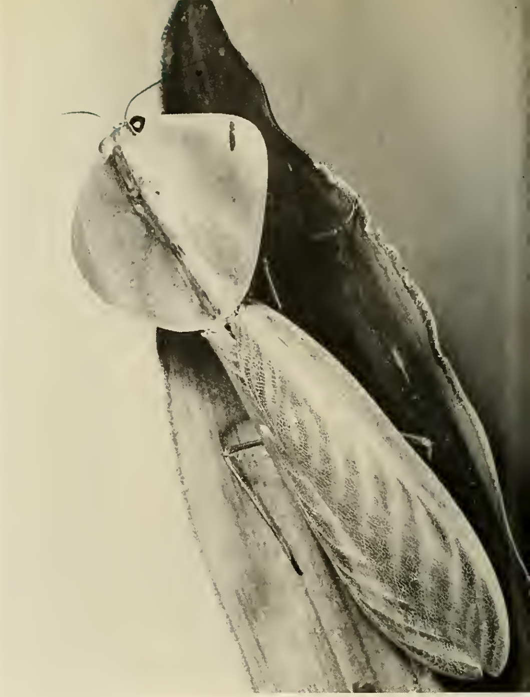


Photo by Lorus J. and Margery J. Mi

▲ A PRAYING MANTIS from Panama. In addition green coloration, it has leaflike extensions from its bo that heighten the illusion

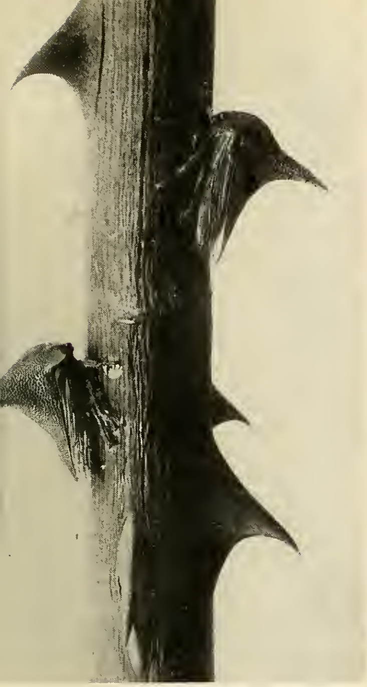
and as quickly return, with the prey clutched between. Sharp teeth on the inner surfaces of the legs provide a grip as inescapable as the spikes that lined the Iron Maiden of medieval torture chambers. The mantis is an insect trap, and its ambush technique is aided by the creature's resemblance to harmless herbage.

Much of this imposture depends upon the mantis standing still. The caterpillar that approaches may be a brown inchworm, measuring its path in a characteristic looping gait. If the mantis is so hungry that it moves toward the larva, the latter may recognize approaching doom or feel the quiver of a twig—warning enough to induce the caterpillar to use its own concealment. The inchworm may then cling to the branch with its hinder pairs of legs, while letting go with the front set of six and extending its cylindrical body as though it were a mere leafless branch, forking from the stem at an angle of some 60 degrees. As long as it retains this pose, the mantis is unlikely to attack. If the patience of the hungry mantis is less than the seeming trance of the sticklike inchworm, the bigger insect may move off and the caterpillar survive to become a flying moth with angular wings. Instinctive actions and protective appearance go hand in hand if survival value is to be achieved.

Certain birds make life precarious for many insects. But a few of the true bugs, called Tree Hoppers (or more imaginatively, "Insect Brownies"), have an extraordinary projection from their armored backs, which causes them to look like a thorn or bur. Sometimes the hopper comes to rest with the thorn pointing in the wrong way, but few birds are good enough botanists to quibble over this detail.

In evaluating protective resemblances, it is always most important to bear in mind that man's vivid imagination may suggest similarities that have no significance in terms of survival. The habits of the animal must always be taken into full account. Thus for any of our long-horned grasshoppers to escape capture by resembling green leaves, the insect must remain silent and motionless, for the most part, all day long. It can become active only after the sun has set, when most insect-hunting birds are asleep. And when the long-horns go flying through the night air, as they often do, their protective resemblance is of no avail. Some owls catch them in remarkable numbers.

Resemblance to foliage and plant parts by no means exhausts the possibilities of protective body form. Several caterpillars and a few moths spread out on leaves in an irregular mound of mottled colors that simulate closely a bird dropping splashed on the vegetation. As long as these insects remain motionless, they may be missed repeatedly by hungry birds. Similarly the many leaf beetles that have short, cylindrical bodies with irregular upper surfaces appear to be fecal pellets of caterpillars rather than objects that might contain nourishment for a bird. If disturbed, most of them retract their



Leonhardt photo from Black Star

When is a thorn not a thorn? When it a certain Central or South American tree pper, *Umbonia crassicornis*

legs and antennae into protective grooves and tumble to the ground, out of danger. Under the microscope, these beetles are beautiful—with iridescent, sculptured bodies that reflect the light. But on a leaf, with no more magnification than a bird's eye gives, their imitation of waste material is remarkably convincing.

Sometimes it is difficult to explain the strange appearance of animals by anything but coincidence. A Lantern Fly of the American tropics (*Laternaria* sp.) has an enormously enlarged, hollow projection from its head. This extension, if viewed through a hand lens, is astonishingly like an alligator's head—with protruding "eyes" above, a snout, and a long mark on each side that is decidedly similar to the elongated mouth and exposed teeth of the reptile. But what bird that fears alligators goes around with a hand lens, to be frightened by this apparition? Early explorers brought back specimens of this fairly common insect and also tall tales of how

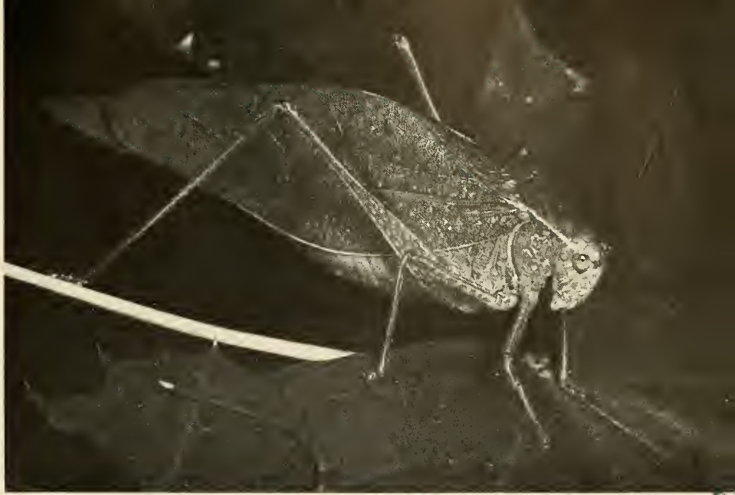


Photo by Lorus J. and Margery J. Milne

▲ **This common long-horned grasshopper** of New England matches its background of foliage so well that the naturalist may have to search closely to find it: another example of resemblance having survival value

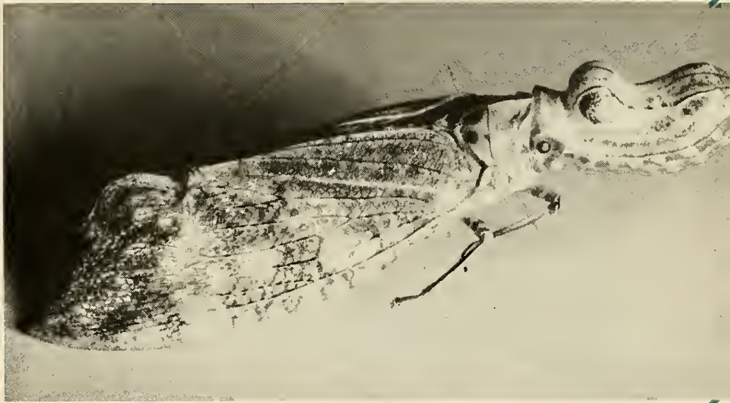
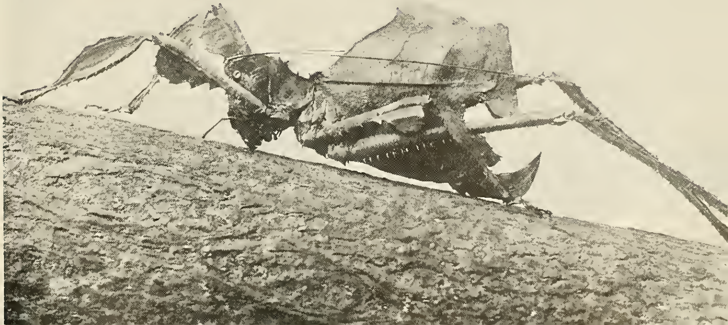


Photo by John C. Pallister

▲ **If sufficiently enlarged,** the fore-part of a lantern fly reminds us of an alligator's head. But it is doubtful that any of the insect's enemies would be frightened away by such a comparison. This seven-inch specimen from Peru, though large for an insect, is far below the dimensions of an alligator

▼ **A West African** long-horned grasshopper that simulates a withered leaf: the masquerader known as *Acridoxena hewaniana*

Leonhardt photo from Black Star



its head glowed like a lantern in the dark—hence the name "lantern fly." All large museums receive examples each year, sent in as "rarities." The luminescent story has not received verification. And so far, no one has produced an adequate explanation for the extraordinary development of the lightless lantern fly's head.

Sometimes it is difficult to imagine why a certain insect is avoided by an animal. A number of Ghost Crabs (*Ocypode*) that shared the authors' apartment one summer were tested repeatedly with freshly caught insects for food. All were highly acceptable—except fireflies. These were either rejected or ripped apart and then thrown away. Yet toads sometimes eat enough fireflies to turn them into animated lanterns, the unquenched lights shining through the stomach wall.

Many animals learn what may be eaten and what may not by trial-and-error methods. A bird clearly develops a tendency to avoid a hornet or a stinging caterpillar after a single try has proved distressing. The insect eater learns to distinguish the objectionable prey (and anything resembling it) as thoroughly unsuitable for food.

An insect that is avoided because it is recognized as an unpalatable, malodorous, poisonous, stinging, or biting creature does not need camouflage. In fact, bold coloration with a maximum of contrast would help to advertise its presence. Sure enough, skunks are plainly marked in black and white—the utmost of contrast—and they walk about so deliberately, fearing no attack, avoiding no enemy, that motorists and locomotives run them down by the score. Yellow and black Zebra Butterflies, and others of the heliconiids which are known to be distasteful to monkeys and birds, are vividly banded. Young animals will try one heliconiid butterfly but not a second. Like the skunks, these insects bear clear warning patterns and can afford to be most deliberate in their movements.

The many kinds of bees and wasps resemble each other more in color and pattern than would be expected in so large a group. But as Fritz Mueller pointed out in the middle of the last century, stinging insects enjoy a distinct advantage if they have a general similarity in appearance. If each kind of stinging bee and wasp had a different appearance, a much larger number of individuals would be killed in educating each bird than if a lesson learned from one experience could apply to many. Hence, evolution seems to have favored the development of similarity among these well-armed insects.

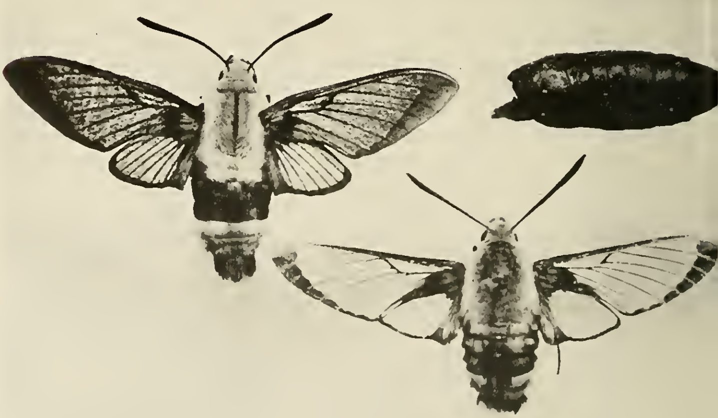
A badge of immunity may be counterfeited. The drone fly, so like the honeybee, demonstrates how freedom from attack may be achieved by a lamb that wears wolf's clothing. The closer the resemblance, the fewer times a drone fly is eaten by a bird. The flies frequent the same flowers as the bees and mimic them wonderfully well. Even the robber flies that attack honeybees to suck out the contents of the honey-gatherer, using a technique that protects them from being stung, follow the same procedure with the drone flies, which could not sting if they wanted to. The carcasses of both insects often accumulate under a favorite perch of the hairy, predatory flies—as a cemetery of empty shells, mimic mixed with model.

The drone fly belongs to a celebrated group of aerial acrobats with perfect wing control—the Hover Flies. They are members of the family Syrphidae. Many of this great group of interesting insects mimic the bees and wasps in body form, pattern, and habits. Some are slender like hornets, others robust like bumblebees. A few of them use their disguise to enter undetected into the nesting areas of the more industrious bees in order to rob them of their food stores or lay eggs that will hatch to maggots and fatten at the bees' expense.

Even beetles mimic bees, particularly bumblebees, and frequent flowers. The so-called Bumblebee Flower Beetle (*Euphoria*) is often seen in spring, flying a few inches above the ground in nicely controlled flight, entering among canes and other low-growing vegetation, humming very much as does a home-hunting bumblebee. In the South, the Figeater is another scarab that is easily mistaken for a bumblebee as it visits flowers and

▼ BUMBLEBEE HAWK MOTHS quickly lose their dark wing-scales after emerging from the pupa at upper right. Then, with clear wings (*lower right*), they flit from flower to flower like a bee and enjoy the protection of a sting they do not possess

Photo by Lorus J. and Margery J. Milne



ripe fruits. The curled, white, grublike young of these insects feed upon roots, however, and the parents make no known use of their similarity to bees except as it frees them from attack by birds.

A few moths that are active by day are readily mistaken for stinging insects. The Bumblebee Hawk Moths emerge from their pupal shelters in the earth with a full covering of overlapping scales on their wings, just like those worn by others of the Sphinx group. But most of the scales fall off as soon as the wings are used, and before long the insect is as clear-winged as a bee. Even the antennae are shorter, blacker, and more clubbed, as though in imitation of the prominent elbowed antennae of the armed insect. Clearwing moths of the more slender aegeriids have a closer resemblance to wasps and are active on the same flowers at the same time of year. Presumably they enjoy freedom from molestation by virtue of the "pointed arguments" the stinging models carry.

Ants, too, have their mimics. Some longicorn beetles and several true bugs resemble ants in markings, body dimensions, and manner of walking. But an assortment of insects from various groups actually associate themselves with ants, acquire the odor of the anthill, and roam about freely within it. They feed on the stores of food that the ants accumulate and even beg drops of regurgitated nourishment from their passing hosts. These "guests," properly called inquilines, form a most interesting addition to the anthill population. There can be no question but that their similarities benefit the mimics.

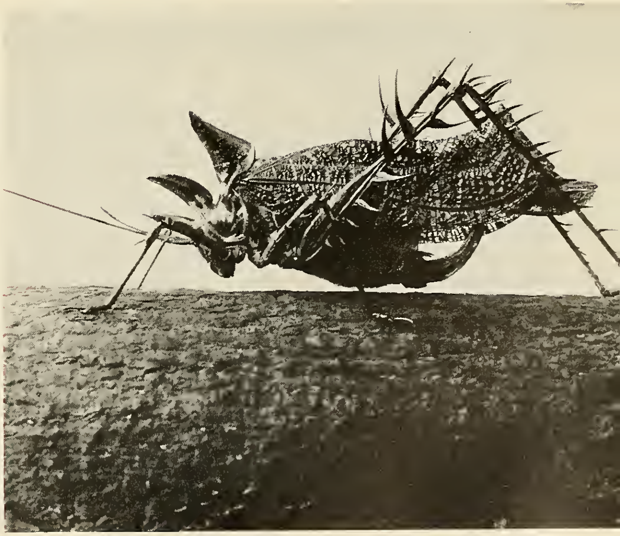
If it is to profit by the disguise, a defenseless animal that resembles an armed one must always frequent the same places as the model, at the same time of day and year. The Leaf Fish, *Lobotes surinamensis*, is an interesting case in point. The young of this fish closely resemble the floating dead leaves of the red and black mangrove among whose leaves they make their home. And when a handful of the leaves was tossed into an aquarium containing one of these fish, it immediately moved toward them and literally "schooled" with the leaves. It lives on its side near the surface, with its body curved downward in a slight arc and often with its head slightly lower than its tail. It moves lazily through the water by means of transparent pectoral fins, so that there is no appearance of muscular activity. The fish is yellowish-tan, marked with brownish-black spots, and it reaches the right size at just the right time. In summer, the leaves are bright green, but in the autumn, when most of them fall, they turn yellowish and finally brown or nearly black. The fish apparently reaches the right size to enjoy protection when the leaves themselves have come to resemble the fish most closely.

It was Henry W. Bates, an explorer of the Amazon basin a century ago, who first pointed out that harmless and dangerous creatures are sometimes encountered in the same region and in a similar guise. This sort of mimicry has been called Batesian mimicry ever since. We see an example in the harmless Harlequin Snake, which lives in the same territory as the poisonous Coral Snake. Though unrelated, it has the same alternating bands of scarlet, black, and yellow—though in a different pattern. If one does not memorize how the colors alternate, it may not be easy to tell the poisonous snake from the harmless one on

Continued on page 239

▼ A FLY that looks like a wasp. The Soldier Fly has lemon-yellow bands arranged like those of the wasps that frequent the same flowers. It also has conspicuous antennae that are elbowed like those of the stinging bees and wasps

Photo by Lorus J. and Margery J. Milne



▼ A GROTESQUE EXAMPLE of leaflike mimicry: a long-horned grasshopper (*Markia hystrix*) from Panama, Colombia and Brazil

Leonhardt photo from Black Star

New Mexico State Tourist Bureau ph

THE *Great White Sands*

Our most extraordinary desert beckons those who seek the truly bizarre—a curious assemblage of persevering plants and ghostlike animals struggling amid a snowy sea of dunes

By Nell Murbarger

MICE and lizards of snowy whiteness, yuccas with stems 40 feet long, sand that isn't sand, lakes of crimson water—these are some of the tales that are told of New Mexico's Great White Sands. Thrice difficult is it to winnow the wheat from the chaff—to declare with certainty, "This is fact" or "This is fable." Chiefly this is so because there is still much unknown about this strangest and most spectacular of our deserts—this 176,000-acre wilderness that looks like a stage setting of the Sahara done in granulated sugar.

These undulating white dunes extend across more than 200 square miles of territory and bear no relationship to silica or quartz sand, being composed of 99 per cent pure gypsum crystals and 1 per cent quartz and other impurities. They were already known to Spanish explorers when Virginia was still a struggling colony of the Crown.

When pioneers first settled in the Tularosa Basin, in what is now south-central New Mexico, they felt only hatred and distrust for these ever-shifting hills, fearing that the dunes would eventually swallow homes and ranches, even the growing settlements. Yet even as they feared the spectacular white sea, these early settlers found themselves drawn irresistibly toward it; and whenever time and Indian troubles permitted, they packed lunch hampers and journeyed by horse and buggy to "The Sands," there to spend a day picnicking and playing.

Closer acquaintance saw the earlier dread replaced by a feeling of friendliness, and as the population increased roundabout, the sands became a popular site for

MERICA'S "LITTLE SAHARA" covers
r 200 square miles and is composed
shifting dunes of almost pure gyp-
, gleaming white like granulated
ar

Western Ways photo by Ray J. Manley

▲ THE TRACKS of yesterday are erased tomorrow in the dunes of the Great White Sands. But troublesome sandstorms occur only when the wind is very high

church suppers, lodge gatherings, Sunday School picnics, Easter Egg hunts, weiner roasts, school play-days, and moonlight frolics. But all these visits were strictly marginal affairs, and until fairly recent times the heart of the Great White Sands remained virtually as little known as the Gobi. Not only was it a land completely devoid of surface water, said local legend, but it was a place where no form of life existed—plant, animal, or insect—a gleaming wasteland, as barren as the arctic and as hazard-fraught.

In these same White Sands, however, people of the Tularosa Basin realized that they had a scenic wonderland unlike any found elsewhere, and about 1922 they began a decade-long fight to set aside a portion of the area as a National Park or Monument. The late Tom Charles, then Secretary of the Alamogordo Chamber of Commerce, was named Chairman of a special White Sands Committee. Year after year, Charles made the Sands project his special baby, working either alone or in co-operation with Sands-minded officials of other communities as far distant as El Paso.

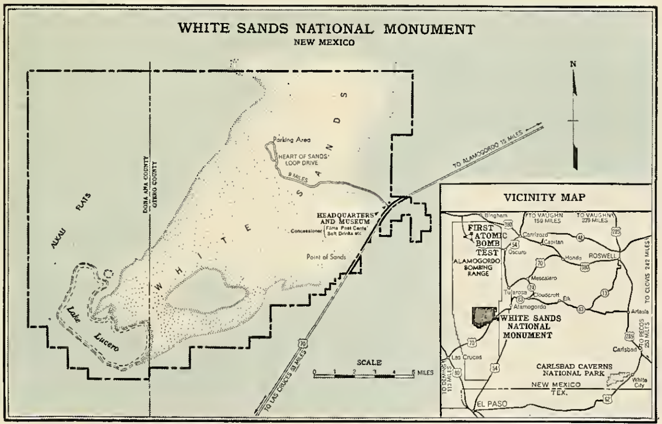
While Secretary of the Interior A. B. Fall and New Mexico's U. S. Senator Bronson Cutting were both giving the issue their wholehearted backing, there was the usual opposition from enemies of conservation. At last, about 1929, a government representative was sent to appraise the merits of the place. Arriving there he found a region whose fringes had been overrun by picnickers for two generations, while its interior, so far as he could learn, had been seen by no man except from a distance!

It was Tom Charles, naturally, who accompanied the official party in the capacity of guide and general trouble shooter. The "invasion" was no sinecure; not even a wagon trail had ever been built into the region. From the south and west, entry is precluded by the several thousand-acre expanse of swampy Lake Lucero, while from the north or east the steep lee sides of the dunes present a formidable appearance. It is impossible for a vehicle to climb the leeward faces, but the flats between are firm, and it is possible to follow a zig-zag course.

"After four and one-half hours . . . of shoveling down the sandhills and throwing in scattered stalks of yucca to make the road passable," wrote Mr. Charles in his description of that initial inspection tour, "we arrived at a point where we were satisfied that we were in the Sands proper."*

By the time this exploratory journey was completed, Uncle Sam's representative was fully convinced that this was one of nature's true marvels—an area unlike anything else in the world and certainly a place worthy of recognition as a National Monument.

Others, unfortunately, held quite


WHITE SANDS NATIONAL MONUMENT
NEW MEXICO
N
WHITE SANDS
ALKALI FLATS
Lake Lucero
DONA ANA COUNTY
OTERO COUNTY
Parking Area
HEART OF SANDS' LOOP DRIVE
8 MILES
TO ALAMOGORDO 15 MILES
HEADQUARTERS AND MUSEUM
Concessioner
Films Post Cards Soft Drinks etc
Point of Sands
TO LAS CRUCES 63 MILES
70
SCALE
0 1 2 3 4 5 MILES
VICINITY MAP
Bingham
TO VAUGHN 158 MILES
TO VAUGHN 239 MILES
FIRST ATOMIC BOMB TEST
ALAMOGORDO BOMBING RANGE
Carrizozo
Capitan
Oscuro
Hondo
ROSWELL
Mescalero
Tularosa
Cloudcroft
Elk
Alamogordo
WHITE SANDS NATIONAL MONUMENT
Artesia
TO CLOVIS 242 MILES
TO PECOS 250 MILES
Carlsbad
Las Cruces
CARLSBAD CAVERNS NATIONAL PARK
White City
NEW MEXICO
TEX.
EL PASO
TO DEMING 113 MILES
380
54
48
285
70
24
83
13
80
62

Drawn by H. L. Golder NM-W.S. 7007 February 1947

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*New Mexico Magazine, July, 1932.

Photo by Hubert A. Lowman

▲ WHERE THE WIND endlessly writes its autograph: a brilliant world of curves and timeless change. Some of the dunes are 50 feet high

different views. While this great white desert had lain unused longer than any man knew, commercial interests rose in alarm as soon as it was under serious consideration as a park reserve. As one of the world's largest gypsum deposits, they declared, here was potential revenue far too great to be "wasted" on recreation alone. They cited the staggering value of the Sands for fireproofing material, for wallboard and tile, wall plaster and exterior stucco; as plaster of Paris and casting plaster for surgeons and dentists; as a retarder in Portland cement and a filler in paint, paper, and fabrics; and as a fertilizer and soil conditioner. In short, the world was suddenly represented as turning on axles of gypsum.

Such protests were laughed down when it was statistically shown that the Great White Sands deposit contained a conservative *thirteen billion tons* of gypsum—a supply sufficient, it was declared, "to reproduce the fireproof walls of every skyscraper in America, to duplicate every piece of wallboard that has ever been manufactured, to replace every piece of inside decoration and statuary on the American Continent . . . and still not interfere with the one-third of the Sands which is to be set aside as a national playground."

Accordingly, in January, 1933, the choicest portion of the Sands was designated as a National Monument, and the first road into the dunes was built. On April 29, 1934, the new Monument was opened to the public by the man who had led the ten-year effort for its creation. He had been appointed Custodian at a salary of one dollar a year.

"Naturally, that salary wasn't all velvet," Tom Charles liked to remark in later years. "I had to furnish my own car, gasoline, and postage stamps . . ."

During the first year of Monument status, the dunes were visited by 34,000 persons, and the number nearly doubled during the second year. Today, as America's sand pile extraordinary, this strange white desert is the playground of some 150,000 persons annually, the peak attendance to date having been recorded on July 4, 1949, when 7,890 persons passed through the entrance gate.

Yet, of all those who come here

Western Ways photo by Ray J. Manley

◄ CRYSTALS OF SELENITE, from which the "sand that is not sand" is formed to frolic, comparatively few know the true story of the Sands. Even geologists long disagreed on the origin of the dunes. Some contended that rain and melting snow had carried thousands of tons of gypsum in solution from the surrounding mountains, depositing it in the broad, shallow expanse of Lake Lucero, a natural evaporating pan at the southwest end of the dunes area. Gradual disappearance of the lake water leaves a huge expanse of glittering gypsum crystals. Early geologists believed that the prevailing southwesterly winds caught up this material and carried it to the northeast, there to form the long windrows of dunes.

Western Ways photo by Charles W. Herbert

New Mexico State Tourist Bureau photo

▲ THE GREAT WHITE SANDS provide a favorite picnic ground. But a generation ago the interior of the desert was almost unknown

◄ THE DAZZLING LIGHT of the noonday sun can produce "snow blindness," and sunburn is a frequent penalty for wearing beach costumes in these sealess sands

▼ THE FLATS between the dunes are mostly hard enough to drive over. Cars are now prohibited on the dunes because reckless driving down the steep slopes became hazardous

Ormal I. Sprungman photo

To be sure, this operation is actually going on at Lake Lucero as it has for possibly a million years past, but students of geology now realize that the manufacturing process of the Great White Sands operates on a scale far greater than first believed. Today's explanation is that a great plateau once extended across much of southern New Mexico. Later, a huge block of this high country settled to form the present Tularosa Basin, between the San Andres Mountains on the west and the Sacramentos on the east. Because these flanking mountains were recognized as the

Western Ways photo by Charles W. Herbert

▲ THE SAND CASTLES and man-tracks of the holiday-seekers are obliterated as soon as a breeze resmooths the dunes, and a virgin expanse of snowlike sand awaits the next visitors

remaining ramparts of that plateau, and because both ranges carried gypsum, it seemed logical that the sunken portion of the plateau would be likewise endowed. Drilling the basin floor, geologists found beds of Permian limestone and sandstone, between the layers of which were thick beds of pure gypsum.

With this discovery was born the modern theory that, while the Great White Sands are partially the result of evaporation at Lake Lucero, a much greater portion of the gypsum comes from this underground deposit. Water passes to the surface through capillarity, dissolving the material and bringing it up in solution. Upon reaching the earth's surface, this mineral-laden water evaporates, leaving on the flats between the dunes a salt-like encrustation of pure gypsum crystals, which crumbles at the touch.

Distribution is a simple matter of wind erosion. Every passing breeze, playing its fingers over these crusty flats, loosens the crystal grains and whisks them away to pile on the rising dunes to the leeward.

This, then, is the well-organized factory of the Great White Sands—a plant that operates day and night, winter and summer, year in and year out, without labor troubles and presumably without danger of either overproduction or eventual exhaustion of natural resources.

From Monument headquarters on U.S. Highway 70, a side road leads to the heart of the Sands through a narrow swale bordered on either side by rippled white hills. It is a good road over which motorists travel smoothly and safely; yet the battle for its possession is a never-ending issue between Monument maintenance crews and the forward-marching dunes. Only by constant use of bulldozers and scrapers can the invasion of the sands be met and the way kept free for travel.

For the first several miles out of Monument headquarters, the Sands road leads through a marginal world where bird songs are occasionally heard and scattered vegetation is still to be found. Even here it is obvious that preservation of life is no simple matter.

Probably no other botanist has devoted so much study to the plant life of Great White Sands as Dr. Fred Emerson, Professor of Botany at New Mexico Highlands University, who has collected here 62 species of plants. While seven of these species are so constituted that they can push upward fast enough to keep from being buried by the dune and thus appear to be growing out of the gypsum itself, Dr. Emerson has found that all species must necessarily be rooted in the stabilized flats, either beneath or between the dunes. In some sections of the Sands, particularly near Miracle Point, the only two species of plants known to occur are the purple sand verbena and the burroweed.

The fact that plant life exists in the dunes is in itself a phenomenon of nature, since the sands are completely devoid of nitrogen. Either the plants must "muddle through" without it—a feat not commonly believed possible—or they must derive it from the underlying material or contrive, in some manner yet unknown, to extract it from the air.

Of the 60-odd species frequenting the region, none shows greater adaptability than the yucca. Like small boys striving to view a circus parade over the heads of the crowd, these spiny fellows seem to stand on tiptoe, stretching their necks to the utmost limit in an effort to keep their heads above the encroaching sand. Sometimes only a handful of dagger-tipped leaves marks the burial place of such a yucca, but the leaves will still be green.

Later, as the dune moves on, the disproportionately tall stem is exposed and the crown may be seen teetering precariously in the air. Instances have been known where such yucca stems attained a length of forty feet, nearly ten times their normal stature. Occasionally the gypsum crystallizes to form a hard, tubular casing around the stem, giving it the appearance of a stalagmite or column. In other instances, the sands are so thoroughly bound together by the roots of a plant that after the dune proper has moved on, the closely-knit hillock remains

➤ NOT A MOUNTAIN RESORT but skiin thrills equivalent. The gypsum sand i much like dry snow

Nell Murbarger photo

▲ WHEN THE SKY BECOMES OVERCAST and the sky line is blotted out by wind-blown sand, the visitor may lose his way in the labyrinth of dunes. A tent has been known to become buried in a day

intact, with the plant that caused it still perched on its summit like a golf ball on a tee.

On flats between the dunes one finds Indian rice grass, tufts of grama grass, wiry, gray rabbit brush, burroweed, and ephedra. Now and then there is a small skunk brush or stunted cottonwood tree.

Possibly nothing in this marginal world endures a grimmer struggle for existence than these little cottonwoods. As the encroaching dune creeps slowly higher on the tree's trunk, the sand methodically swallows the lower branches one after another. Deprived of air and sunlight, these branches die, and, as time goes on, roots sprout in their stead. When, in the course of months or years, the dune passes on its way, its departure disentombs the buried portion of the plant, and if life still exists, new branches again sprout from the trunk. The confusing result is an upside-down tree with unanchored black roots and leafy green boughs haphazardly and hopelessly intermixed.

That this marginal world also has its share of animal life is apparent in the intricately patterned tracks that lead from the crusty lowlands to the tops of the highest dunes. Recorded in the sand as faithfully as in new-fallen snow are sprawly lizard tracks and bird tracks, the decisive thumps of strong-limbed jack rabbits, the dainty imprints of tiny cottontails, the doglike pads of foraging coyotes. For a dozen yards the delicate tracery of a pocket mouse's footprints are overlain by the pigeon-toed stride of a cruising desert skunk. Suddenly the rippled surface of the sand shows unmistakable evidence of disturbance, and a single drop of dried crimson stains the white expanse. The skunk tracks continue their pigeon-toed course across the dune. The mouse tracks are no more.

Nowhere has protective coloration been developed to a higher degree than here in the Sands, particularly by animals that are commonly preyed upon by their neighbors. Dr. Lee R. Dice, of the University of Michigan, made an exhaustive study of pocket mice in the Tularosa Basin. He found that in the lava beds a little to the north of the Sands these rodents are nearly black in color, thus affording them protection in the dark lava rocks. In the red hills near by, the pocket mice have definitely reddish fur; while in White Sands they are pale straw color. An interesting diorama showing the three color phases in their natural habitats may

New Mexico State Tourist Bureau photo

Western Ways photo by Ray J. Manl

▲ PLANTS manage to survive the encroaching dunes. Some yuccas have had to elongate their stems 40 feet in order to stay above the surfac

be seen in the museum at Monument headquarters.

White spiders also are said to occur here, and it is not unusual to glimpse small white lizards, whose pale ghostliness renders them all but invisible against the dunes where they spend their lives. An earless lizard (*Holbrookia*), described as an endemic race, and a scaly lizard (*Sceloporus*) are nearly pure white. Also there is a whiptail lizard (*Cnemidophorus*), which is considerably paler than those immediately outside the dunes.

Not all creatures, however, are endowed with this protective camouflage. Brewer's blackbirds are still black, and to see a flock of these glossy fellows alight on the gleaming sands provides one of nature's most striking studies in contrast.

Before the visitor has been long in the Monument, he is certain to note that all the dunes have one characteristic in common, which formerly encouraged a remarkable type of daredeviltry. Due to the prevailing southwesterly winds, the dunes have a gently sloping grade on their southwest exposures, while their leeward faces drop away with relative abruptness. For all its soft and velvety appearance, the crystalline material composing these dunes is heavy and firmly settled; and until Monument authorities forbade the practice, it was considered rare sport to travel over the dunes in a speeding motor car.

Zooming across the windward incline to the summit of a dune, the driver would cut the power just as his machine, in roller-coaster fashion, headed down the steep northeast declivity. With the hilarious and terrified shrieks of passengers lending drama and confusion to the experience, the car would go into a nose dive, its wheels locked and the whole propelled forward on the crest of a miniature avalanche. Reaching the base of the dune, the machine would somehow recover its balance, zoom off across the flat and up over the crest of another dune, there to stage a repeat performance.

As visitors increased in number, the practice grew extremely hazardous, and frequent signs along the road now warn against such indulgence.

Five or six miles from Monument headquarters, virtually the last of the vegetation grows, and another couple of miles carries the motorist to the end of the road. Beyond this point exploration must be on foot.

Trudging across the flats, up one

dune and down another—particularly during midday hours when the sun is high—the visitor feels he is walking through a glaring white vacuum in which nothing is real. Like a sleepwalker, he automatically lifts his feet and sets them down, yet the only evidence of progress lies in the lengthening trail of footprints he leaves behind him. To the right and left, ahead and behind, the undulating white dunes stretch away to the distant mountains. Unless shielded by dark sunglasses, few human eyes can long endure the brilliancy of this midday light, its effect being similar to the snow blindness experienced by arctic travelers.

By far the best time to see the dunes is during the first two hours after sunrise and the last hour or two before sunset. Then the low-slanting rays of the sun throw heavy shadows into the ripples and accent every slope and contour.

Photographers using light meters are apt to find that the intensity of light is even greater than their gauges will register. Picture-snappers are almost certain to overexpose their film unless they use one of the fastest shutter speeds and smallest lens openings available.

Considering this intensity of light and the complete absence of shade and surface water, one might expect this white wasteland to be an inferno. Quite the opposite is often true. The breeze that blows across the dunes frequently has something of the quality of a sea breeze, and even on the warmest days the surface of the sand may feel cool to the touch. The absence of shade and the strong reflection of sunlight from the sand can make sunburn a problem.

Near the far end of the motor road, on one of the wide flats between the dunes, is situated a large picnic ground and parking area. The National Park Service has provided stoves, tables, and benches, with pole ramadas for shade; and here several thousand persons come to disport themselves each Sunday throughout the season.

Something about the dunes seems to cast a strange spell over sojourners, and only a dyed-in-the-wool hermit could fail to find this picnic ground an interesting place in which to study humanity. Possibly its nicest feature is the almost complete absence of Thou-Shalt-Nots. Here, at last, is something that the Great American Public has discovered no way to damage.

Before the last weiner has been roasted and the last campfire has died to smoldering embers, the average Sunday evening at Great White Sands sees the picnic area tramped, tunneled, tumbled, and turned upside down. But long before another week end has rolled around—generally within 24 hours—the sand castles are leveled, the pirate caves refilled, and man-tracks obliterated, leaving the area again spotless, perfectly sculptured, and self-possessed. Responsibility for this amazing clean-up job lies with the wind, which plays lazily over the dunes, moving the sand forward on a 30-mile front at an average rate of several inches each year.

Harrowing tales of blinding sandstorms in the Great White Sands are sometimes told. It cannot be denied that a person without a good sense of direction might become lost under certain circumstances. When the wind is high, all landmarks sometimes remain obscured for hours. One scientist familiar with the region traveled in a sandstorm all day under a cloudless sky without ever seeing the sun. And when he returned to his tent, he found it entirely covered with sand. But in any normal wind, the crystallized gypsum only rolls along the surface, and if a handful is tossed into the breeze, it falls back to the ground, leaving almost no trace of dust in the air.

A story has gotten started that a herd of antelope makes its home here and has hooves that curl back like a court jester's cap, because of lack of grit to wear them down. But Monument Superintendent Johnwill Faris has never encountered such an animal during his ten years at Great White Sands, and for lack of evidence we must put the tale down as highly doubtful. Yet the story still persists, and any number of reputable persons in the Tularosa Basin will swear to its authenticity.

Then there are the transient lakes of vermilion-colored water. Spanish legends dispose of the matter conveniently by asserting that the lakes are visible only on the anniversaries of certain bloody battles. Cattlemen of the region, on the other hand, declare that the strange pools make their appearance with considerable regularity, generally in the fall of the year.

When I put this question before the New Mexico School of Mines, they parried with one of their own: "Did you ever *see* one of these lakes?" I have not. But Natt N. Dodge, Regional Naturalist, asserts that, although descriptions have exaggerated them, he has seen patches of "red" water in Lake Lucero, probably in September. What appeared to be concentrations of algae in small lagoons along the shores of the lake gave a distinctly red cast to the water.

There is still much for us to learn about the Sands. Probably no man ever knew them so thoroughly or loved them so devotedly as their first official custodian, Tom Charles.

"To you who have never seen the Sands," he wrote, shortly before his death, "I want to invite you to come, and I hope that you see them on an evening just as the setting sun breaks through a canopy of clouds above the rugged San Andres, painting the points of the hills in yellow and gold, with here and there a burning ball of fire; that the mountains themselves are purple and blue and the deep shadows of the Sands stand out against the snow white hills . . . As you linger in the twilight . . . peering into the darkness and listening to the silence of the desert, without the whisper of a single leaf, I hope that you turn, half frightened, and face the full red moon as it rises over the Sacramento Mountains, scattering its millions of diamonds over every rippled dune.

"Then you will have seen the Great White Sands."

U. S. Fish and Wildlife Service photo by Warden Carl Loy

▲ THE ADULT SEA OTTER looks like an old man, with grizzly hair and bristly mustache, but it lives and plays like a child. At maturity, it is 55 inches long and weighs 50 pounds

MORE Sea Otters

Under the protective eye of the Fish and Wildlife Service, these fabulous "old men of the sea" are returning from the verge of extinction

BECAUSE sea otter pelts were worth their weight in gold when the Russians came to Alaska, the animal was hunted relentlessly and was eventually all but exterminated. Some pelts were said to have sold for $2500, though the average was much less. In the mad struggle for the fur trade, the early traders from Asia enslaved many of the native men, working them to death or killing them before sailing away, and there was mass murder of whole settlements of native Aleuts.

Soon after Alaska was acquired by the United States, killing of this unique animal was rigidly curtailed, and in 1910, when the otter seemed doomed, complete protection was given. During the last decade, a long-range program to increase its numbers has been under way. It is now reported that there are more than 8000 sea otters in the Aleutians-Alaskan area. These are independent of a small herd that has been rigidly protected by the state of California. In former times, sea otters were found all along the Pacific Coast.

Few photographs of the animal existed before the ones shown with this article were taken. The U.S. Fish and Wildlife Service is undertaking to create new colonies through the transplanting of small numbers to favorable areas.

During the early part of this century, about all that the Federal Agencies that were charged with the protection of the sea otters could do for the animals was to maintain secrecy about the location of small groups that were known to exist. The Agencies did not have the necessary funds for much patrol work. In the 1930's, however, the Navy and Coast Guard gathered evidence indicating that Japanese "fishing craft" might be netting sea otters illegally in Alaskan waters. It was the sighting of a Japanese vessel, indeed, in an inlet of Amchitka Island that started the present management program. The seagoing ship had entered an inlet where no ship could possibly be afloat—according to Navy charts. The charts indicated that the inlet was filled with rocky reefs, which would surely destroy any ship. The Japanese ship, however, on sighting the Navy vessel, put on steam and sailed away, right over the "rocks." Investigations showed that the "rocks" were really rip tides that created an illusion of reefs.

In the inlet was found a large group of sea otters. Hidden away from hunters and pirates, the otters had lived and multiplied for many years. The Bureau of Fisheries then received a small appropriation from Congress for the establishment of a sea otter station on Amchitka. When the Bureau of Fisheries and the Biological Survey were consolidated in 1940 to become the Fish and Wildlife Service, the sea otter management program was given impetus.

During the war years, sea otters began to multiply in their relative security. Now there are about 4000 on Amchitka and about the same number scattered in small groups along other islands and coastal areas.

The Fish and Wildlife Service reports that the sea otter cannot live except along certain shore lines. It needs an area where the water is comparatively shallow, as off shelving beaches. In such localities sea urchins live, upon which the otters feed mainly. There also must be kelp beds, in which the otter can rest, play, and hide from killer whales. Killer whales and man are the sea otter's two worst enemies. The otters are constantly on the alert for them, occasionally shading their eyes from the glare of the sun with their paws to look for the single large fin of a killer whale cutting through the water or to spot man's boats approaching.

The sea otter has so many of the characteristics or mannerisms of people that it is often called the "child of the sea" or "old man of the sea." The two names are not as contradictory as they first appear. While the 55-inch long, 50-pound adult looks like an old man, with grizzly hair on head and shoulders and a full, bristly mustache, it lives and plays like a child. The sea otter undulates through the water with a scissors kick, now and then rolling over on its back to kick itself along with one foot—its forepaws complacently resting on its chest. The sea otter's chest also serves as its table. On it, the otter spreads sea urchins as it tears them apart. While nibbling one tasty bit, the animal is apt to lose another to the floating sea gull that lazily swims about the "table" looking for an unguarded piece of food. After finishing lunch, the otter rolls over a few times and scrubs itself on the head and neck with its paws.

To date, there is no record of sea otters being kept alive in captivity for more than a few days. Perhaps with better knowledge of their specialized food habits it may become possible. But the attempt must be regarded pessimistically until proved otherwise by careful experimentation. Meanwhile, we shall have to content ourselves with the reports that issue from the scientific custodians of this fabulous little animal.

▼ A STUDY IN COMFORT: a sea otter floating on its back and kicking itself along with one foot—its forepaws complacently resting on its chest. The chest also serves as a dinner table

U. S. Fish and Wildlife Service photo by Robert D. Jones, Jr.

A Shaggy Tree

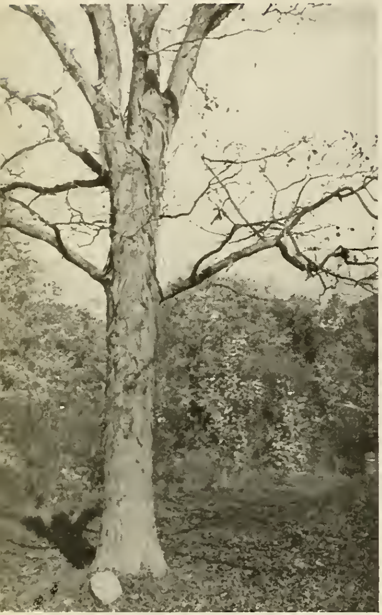
By Dorothy Freas

Looking up the trunk of the tree, it seems to be losing some sort of shingles. Ten-inch pieces of bark are flapping in places, but next year, when you see it again, the same sections will be hanging loosely, giving this shaggy appearance. Hence its name, Shagbark Hickory (*Carya ovata*).

It is a tall tree, about 80 feet high, with a slender trunk. The branches come out at sharp angles and are smooth and gray.

In the spring, it grows light green flowers. By summer, there are waving branches of compound leaves (usually five), but all the squirrels and small boys wait for autumn when the large leathery nuts fall. Although hard to get to, the kernel is amply rewarding.

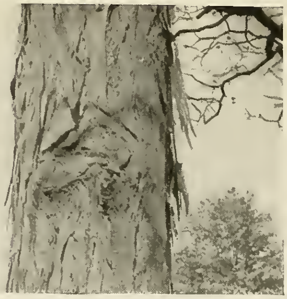
The wood of this tree has commercial value. It is a long-wearing lumber, good for ax handles and wagon wheels, where toughness is necessary.



▲ THE SHAGBARK HICKORY

▲ THE LARGE leathery nuts attract squirrels and small boys in the fall

▼ THE BARK flaps like loose shingles in the wind



THE FIRST ASCENT OF EL SANGAY

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ma herrani. The mossy outside of the nest, in a niche twenty feet above the stream, was soaked like a sponge and dripped water continuously. Neverthless, the interior was dry. Two weeks later the owner was still working on it! The perseverence of these birds through weeks of storm was beyond human comprehension. That this feathered electron, splashed with the fire of the tropics, should choose as an abode a barren, water-soaked wilderness of ash left the mentality of luxury-craving humans in complete coma.

Not 100 feet away on the same bluff was the nest of a still rarer hummingbird, the Black-throated Bronze-tail, *Metallura williami atrigularis* Salvin. Its home, too, had never before been found. Two other nests were discovered in the paja grass in the same valley, one of them beside a large rock in the stream.

The place where three rivers came together, the Indians called "Tres Aguas." The outlook here was not auspicious. We were facing the Rio Negro. In its angry waters disaster lurked. The previous evening the Alao peons had refused to build an adequate *chozo,* or lean-to of grass. They huddled all night and arose wet and disgruntled. The "waterproof" covers of our sleeping bags leaked like sieves. Films and cartridges were wet. The drenched wood could not be coaxed into flame. We ate cold meals. We were in a cul-de-sac between mountain walls and could see nothing but fog and mist. Even the two faithful Quechuas were discouraged.

On the twenty-fourth, Waddell and Lewis arrived with six sullen peons. On the twenty-fifth, I gave orders to cross the river. The peons revolted. They pointed with fear at the rising El Negro and protested that, if we crossed, the daily rains would swell it to frightful proportions and prevent return. While I attempted to dispel the leader's fears, the rest of the peons slipped through the grass and fled over the mountain. They took our remaining venison. Terry and Waddell chased them in vain. For three days we waited—and watched food supplies diminish. Waddell went to Alao, sleeping in the snow on a high mountain range without adequate covering, and returned with new peons and a cheering letter from my wife. Meanwhile the rains continued. Dryness was no longer an exact state—only a comparison with something more water-soaked. The encouraging letter and the lucky kill of a deer[5] by the leader helped us to carry on and essay the Negro.

The fording of the river was accomplished without injury or loss of equipment, and the fears of the peons subsided temporarily. We climbed to the mountaintops again.

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[5] This species, of which we took several skins to the States, proved to be *Odocoileus columbicus consul,* a very rare animal. Dr. Wilfred H. Osgood of the Chicago Natural History Museum advised that there was at the time only one specimen in the museums of the world—a female in Stockholm, Sweden.

Following a watershed that gave uncertain footing on its jagged edges, we came to a jutting escarpment, which we called Desolation View. No one could exaggerate the ghastly panorama that filled the enormous basin below us. It was the Grand Canyon all over again but done in blacks and livid grays and filled with a spectral atmosphere. We continued along the knife-edge for the rest of the day. At times it was only two feet wide, with yawning chasms on each side. Late in the afternoon it opened out into a wide plateau, more than 13,000 feet in altitude and covered with endless paja and a few stunted trees. The leaves and trunks resembled pear trees, but the yellow flowers reminded one of flat-topped goldenrods. On the eastern escarpment of the plateau, Lewis located dilapidated chozos made of grass. These may have been the remnants of Dyott's Windy Ridge Camp, the last trace of his route that we encountered. The peons called it "Carniceria" (the Meat Market), because of the tapirs available. This is probably not the "Carniceria" of G. Edward Lewis' article in *National Geographic* Magazine, January 1950, page 134.

The next morning Terry took the peons back to Tres Aguas to bring up the rest of the supplies. So diminished was their number that double trips had to be made each time camp was moved. Terry's feet were now badly infected, but with characteristic disregard of self he made the return trip in one day.

From Windy Ridge to his Cinder Gap Camp, Commander Dyott tried two routes, one along the plateau, the other into the Labyrinth. Of the latter, he said, "A worse one could not have been chosen!" As our peons also refused to follow the plateau, Lewis undertook a reconnaissance into the Labyrinth with the only Indian who still claimed to know Dyott's route. They lost themselves in its intricacies, and the Indian finally admitted ignorance of Dyott's course. But the killing of a deer and a rare tapir, *Tapirus roulini*, revived our waning courage.

That night we witnessed an awe-inspiring vision. As we stood on the brink of the escarpment, the filmy curtains of the Shroud rolled back. Gradually the mysterious God of the Snows was disrobed before our eyes. Drape after drape slipped away and dissolved. The disrobing began from the base upward. First the great flanking buttresses of ash and lava took form; next the lower edges of the snow fields, where irregular tongues of white forked into the gouged sides; finally the icy shoulders shook themselves free, and the perfect cone came out against a methyl blue sky. Save for a singular black spot near the apex, the mighty head was perfect—a sublime and majestic being who might have come to Earth from chaotic mountains of the Moon to take part in creation of abysses and chasms as strange as those of our satellite—abysses that now were taking on grotesque shapes in the palpitating gulf at our feet. As we gazed, a huge billowing cloud of pure gold swept in from the "Oriente" and, half circling the mountain, passed off to the south. To the east the sky assumed a violet light, while to the west cloud masses, already dulled by approaching night, leaped up in pink foam. Night brought the usual deluge and biting temperatures.

In the morning the peons refused to move. They were tired and wanted to feast on tapir and deer. Neither arguments nor offers moved them. Their only answer was, "Mañana!" I feared desertion, so during the day they were kept under surveillance.

Personally, I spent the night listening for sounds from the chozos. Another defection would spell failure. With fatigue and the accumulated pain of hardship and frustration heavy upon us, this was in some ways the darkest moment of our expedition.

(In the next issue of NATURAL HISTORY, *the author will tell of the remaining episodes in the first successful attempt to scale El Sangay.)*

HOAX OR FAIR WARNING

Continued from page 227

first glance. Of course, a mimic must never become so numerous or conspicuous that its potential enemies can easily "catch on." The value of mimicry would be destroyed if many of the mimics could be eaten before the creature preying on them tackled the dangerous or unpalatable model.

Unfortunately, a great deal of uncritical writing has been published on mimicry among butterflies without clear evidence that the model is less desirable as food than the mimic. The similarity in coloration between the Viceroy Butterfly (*Basilarchia*) and the Monarch (*Danaüs*) has been pointed out repeatedly without a good case being made for any relationship beyond coincidence. The range of the two is different. They do not fly in a similar manner or frequent the same areas to any appreciable extent. The viceroy is regularly smaller than most monarch butterflies. Yet little has been done to settle the argument one way or the other. The butterflies must be studied under natural conditions—in the open, while they are alive and free. The question cannot be settled in an armchair between bookcase and butterfly collection. The best evidence that has come to the authors' attention was provided by an inquisitive ornithologist who tasted both of these butterflies to find out. He didn't like either, but then he was a bird watcher and not a bird. And in this country no one has gone to much trouble to show how many or how few birds catch significant numbers of butterflies and which of the insects are most usual prey. The problem is far from settled. A biting ant or a stinging wasp, a poisonous snake or a scented skunk, provide conclusive evidence in far shorter time. There is no end to the experiments and observations that the naturalist can make in this field of inquiry, and it is a study that has a close bearing on some important aspects of evolution.

ANIMALS OF THE AVALANCHE

Continued from page 214

Winter comes quickly on the high mountain slopes and covers the area with several feet of snow. This leaves only three months that are at all mild, and into this short time is squeezed what we know as spring, summer, and fall. Snowstorms in midsummer are not too unusual, and the temperature nightly drops below freezing.

Winter turns the high mountains into an abandoned wilderness of snow. Most animals either migrate or hibernate to escape the icy blasts. The rosy finches, which normally feed among the summer snow fields, move down into the valleys, and elk herds migrate as much as 50 miles in order to reach mild winter range. The snowshoe rabbit turns white and uses the big snowshoes on his feet to move over the surface of the snow and feed on protruding plants.

Marmots are undoubtedly the laziest members of the alpine clan. They spend about three-fourths of their lives in a hibernating sleep. There is little time between when they emerge in May or June and when they must again begin storing great layers of fat for the big sleep. The callos don't spend quite as much time hibernating as the marmots, nor do they sleep as soundly. It is quite possible that they awake at intervals to munch on food stores.

The cony has devised by far the cleverest method of meeting the winter conditions. In late summer it very industriously gathers food for the winter. Cutting a bundle of grasses almost as big as its body, the cony shoves these crosswise into its mouth and then bounds back to the "hay barn." This is a flat space that has been chosen because it is dry and airy and because there is a jutting rock overhead for shelter from rain and snow—an ideal choice from the standpoint of farming science. Each day a new layer of freshly cut fodder is added to the hay pile, and by the time the first snows arrive the cony has about a bushel of greens that have slowly cured into the most edible hay imaginable. The cony's careful treatment preserves the natural colors of the plants and their fresh fragrance.

What a life of ease the pika has arranged for himself! When several feet of snow pile up on top of his rockslide, most enemies are shut out for the winter. The blanket of snow keeps him protected from temperatures that may drop to 50 below zero in the bleak outerworld. In complete comfort Mister Cony can then relax in his easy chair of soft grass and slowly munch on his larder of well-cured hay.

He exemplifies this group of alpine adventurers who have chosen to live among the talus slides. In an area of extremes in wind, temperature, and storms, they have found protection and a comfortable existence in the rock castles.

MUSEUM ANNOUCEMENTS

Rare Butterflies and Moths

A select sample from what is believed to be the finest and most colorful private collection of moths and butterflies in the world will be on public display at the American Museum until May 11. The exhibit, entitled "Velvet Wings," contains some of the outstanding specimens from the late Mr. Frank Johnson's famous collection, recently acquired by the Museum.

Among the specimens are moths with nearly completely transparent wings—scaled only along the edges—and others with large "windows" in each wing. Other unusual species have tails six inches long from the outer margins of the hind wings. Outstanding among the butterfly groups are those whose wings change color with the reflection of light, from a brilliant blue to black or from a vivid green to tan or white. Represented in the collection are many of the most beautifully colored and patterned butterflies known to exist.

The collection, which recently arrived at the Museum, brings to some 300,000 the number of insects donated by Mr. Johnson to the Museum. Though primarily a businessman, Mr. Johnson's hobby had developed so that he was both a collector and purchaser of insects. He financed several scientists to arrange and prepare reports on particular groups of insects. In addition to aiding collectors in Peru, Brazil, Colombia, Ecuador, Argentina, Guatemala, Mexico, and the West Indies, he sent out numerous expeditions in quest of unusual specimens.

"Oscarette"

Plans for the fifth annual national contest for the best school-made motion picture film have been announced. The contest is sponsored by the American Museum's Service Center in connection with the annual Audio-Visual Aids Institute programs.

The competition is open to all students of junior and senior high schools in the United States. The films must be 16 mm., planned and produced entirely by the pupils, and must not exceed 100 feet in length. A school may submit more than one entry but will not receive more than a single award a year. To enter the competition, the faculty adviser of the group of student movie-makers must secure an entry blank from the Museum, fill it out, and return it on or before June 15, 1950. The film must be sent to the Museum Service Center by December 1, 1950.

The selection of the winning film will be made by a panel of judges. In the event that five films come up to the standards of the Museum, an "Award of Merit" will be given for each of the films accorded second, third, fourth, and fifth places. Last year's "Oscar" was awarded to "Animal Antics," produced by students of George Washington High School, New York, N. Y.

The Planetarium Show

During May, "Our Battle-scarred Earth," a discussion of recent theories, will provide one of the most thought-provoking demonstrations the Planetarium has ever offered.

Other Special Exhibits at the American Museum

May 4—May 14

Hobby Show for Older People
Sponsored by the
Welfare Council of New York City
Knitting, sewing, jewelry-making,
painting, etc.

May 6—June 4

Ceremonies of the Southwest
Lithographs by Ira Moskowitz

May 16—June 16

Second Annual Exhibition of
The New York Entomological
Society

June

NATURAL HISTORY

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xploring the Desert of Death • Cherished Wildernes

len Canyon • Ben East: The Kettledrum Choir of Jun

How to Know the WILD FLOWERS by Alfred Stefferud
Birds' Nests A Field Guide by RICHARD HEADSTROM
Beginner's Guide to SEASHORE LIFE
Leon A. Hausman
Beginner's Guide to FRESH-WATER LIFE
Leon A. Hausman

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The BOOK SHOP

THE AMERICAN MUSEUM OF NATURAL HISTORY
77th STREET AND CENTRAL PARK WEST, NEW YORK 24, N. Y.

LETTERS

Sea Moth

SIRS:

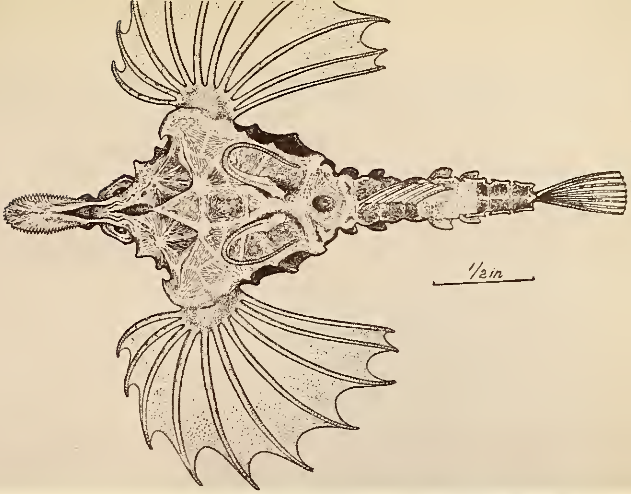
. . . Can you give me the scientific name and distribution of a fish that I know only as "Pegasus"? Despite its name, it is no kin to the sea horse but rather a sort of "boxfish." Specimens occasionally reach this country, dried, in collections of oriental insects, for in this state the fish is sometimes mistaken for a large locust! I understand that it is quite fragile in life and that it spends most of its time at the surface of the water, close to floating masses of kelp . . . The one specimen I have seen was in the private collection of a well-known museum curator, who, for some reason, does not seem willing to give me any further information on the fish. How rare it actually may be, I do not know, but I have been in correspondence with Mme. du Breuil of the Hong Kong Biological Society in the hope that she may be able to obtain a dried specimen for me. Could you give me a little information that might aid this good lady in securing one?

HENRY A. NICHOLS.

Costa Mesa, Calif.

Mr. John T. Nichols, Curator of Fishes at the American Museum, offers the following information:

It is my impression that the dried specimens referred to come from Japan. In this case, they are probably the Japanese species, *Pegasus umitengu*, which is depicted here from a drawing in Jordan's *Fishes.* *



from Jordan's Fishes

▲ PEGASUS UMITENGU, also known as sea moth. (Viewed from below)

The Pegasidae are a family of peculiar little fishes, rarely exceeding four inches in length. They are found in oriental seas, often drifting with the currents. They are also known as dragonfishes or sea moths. Their relationship to other fishes is very uncertain. Different authors have thought them to be related to such unlike fishes as the sculpin, stickleback, and sea horse.

---

* D. Appleton and Co., 1925.

Big Fungus

SIRS:

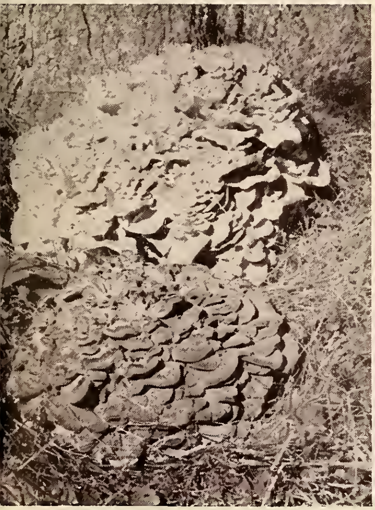
The gourmet rhapsodizes over a steak smothered in mushrooms; but recently a squirrel hunter brought me a large edible mushroom that was capable of smothering quite a few large steaks. I confessed to Mr. Martin Fuhrer, who brought it to the house, that the growth was a strange vegetable to me. Reference to Graham's *Mushrooms of the Great Lakes Region* revealed that it was *Polyporus frondosus,* a large edible fungus that is related to the woody brackets found so commonly on standing or fallen trees. It usually grows on the roots of living trees, and it causes a disease known as "spongy butt rot." Infected trees are deprived of a part of their anchorage and are susceptible to wind-throw.

Our specimen weighed fifteen pounds on the bathroom scales. It was roughly hemispherical in shape, 38 cm. (15 inches) high, and the long axis of the base measured 60 cm. (24 inches). I believe we can say that this specimen reached a very respectable size, because authorities (Lowe: *Bull. N. Y. State Coll. Forestry,* Tech. Publ. 60, p. 38) state that this species may reach a diameter of 50 cm. It grew from the ground on a central stem which branched repeatedly until more than 50 large pilei or caps formed a thickly imbricated roof over the whole structure.

Because of its enormous size, I decided to photograph it next to the trunk of an oak under simulated natural circumstances. A burr oak was convenient. Much to my surprise an eight-pound specimen of *P. frondosus* was growing under this very tree, so I photographed both together. The smaller specimen in front is still attached to its buried wood; the large specimen fitted nicely between it and the trunk of the large oak. Even the smaller mushroom measured well over a foot in diameter, the maximum size reported by Graham. The smaller specimen was cut in two, and the halves were photographed to show the branches that support the imbricated roof.

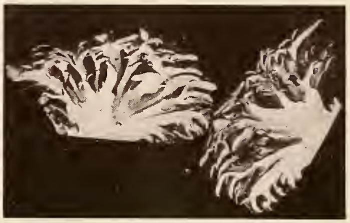
PAUL D. HARWOOD.

Ashland, O.



◀ FIFTEEN POUNDS of edible fungus (upper specimen)

▼ CROSS SECTION of the smaller mushroom



Was He a Genius Among Birds?

SIRS:

The bobolink is one of my favorite singers. No feathered songster of field or forest expresses more fully his joy of living.

On a Maine farm some years ago, one of them made me wonder if there are individual birds with exceptional intelligence and perhaps some creative ability.

One dewy morning I was driving the cows down the lane just as the sun was rising. From bush, tall reed, and fence post the bobolinks were telling the world of their joy in the beautiful morning. Suddenly I heard something new, something added to their standard song. I had heard their song so often that I knew every liquid note, and this new song was an amazing innovation.

Looking around, I soon spotted the singer. Down the lane between two fence posts the top board had been placed on its side. Strutting slowly back and forth on this dewy platform was an unusually large male bobolink. With wings slightly spread, he was singing the novel song. Never did Caruso strut the stage and send out his glorious voice more proudly than did this feathered virtuoso. I listened while he sang his song over and over; to the usual song of bobolinks he had added another verse. The cadence was the same, but it differed from the regular song.

Morning after morning I listened for this song, but I never heard it again. Is it possible that occasionally there is an exceptional bird with creative ability?

Frank E. Watts.

Sarasota, Fla.

The following comments are offered by Dr. John T. Zimmer, Curator of the Department of Birds at the American Museum:

It is very doubtful if any creative ability can be ascribed to this bobolink. Although most individuals of a given species in any region have very similar songs, there are numerous variations due to a number of causes, and it is sometimes possible to identify particular birds by their performance.

The ability to sing is an inherited trait, and to a certain extent, the character and limitations of the song are also inherited. The conformation of the syrinx and its musculature govern much of this ability, but within certain limits variation is possible. Development of the voice is somewhat a matter of growth as it is in humans, and a young cockerel, for example, is not so accomplished a performer as an old bird whose voice may have served as a model. At the other extreme, there are a few species whose young are vocal while the adults are voiceless. Canaries have been reared where they could hear only the songs of another species, and they acquired the song of their unwitting tutors instead of that of their parents. How much of a bird's song is inherited and how much acquired is still a question. Different species may be taught to whistle quite unbirdlike tunes.

Mimicry is undoubtedly widespread among birds. Quite frequently some individual bird will interpolate a few notes from the song of another species or even some extraneous sounds; but it is not always possible to recognize what is being imitated. A still different type of variation may occur when the syrinx is malformed or injured.

In addition to various "call notes," some species have more than one type of song, including, perhaps, an elaborate flight song, and portions of these could, conceivably, be added sometimes to the common production. As far as I know, however, the bobolink has but the one type of song.

Bird song must have evolved from some simpler ancestral utterances, and it may still go on developing into something more elaborate and finished. If evolution is to proceed, some individuals must sometime excel their fellows. The song of a species, in any case, occasionally varies in different parts of its range, but the differences are demonstrated by the general population and not by individuals.

We come back again to our bobolink. Perhaps not all bobolinks would be capable of a similar performance, but that the bird in question was deliberately "composing" is beyond any possibility supported by biological data.

Who Killed Those Robins?

Sirs:

A pair of robins built a nest in a crotch of one of our elms, and we could look down into the nest from one of our upper windows. In time we saw two baby robins in the nest. When they were not quite half grown, a mysterious tragedy befell them. We saw them in the nest at twilight, and a little later the mother bird was brooding them. In the morning the nest was empty. Upon investigating, we found the two little birds dead on the ground about ten feet from the tree where the nest was. They had not been bitten or mangled in any way.

We thought at first that an owl might have taken the mother bird and that she might have dragged the young out in her struggle. To our surprise, however, we soon saw the mother and father robin gathering dried grass and carrying it to a neighboring tree, where they were busily building a new nest.

Do parent birds, obeying some strange instinct of their own, ever destroy their young?

Carlotta E. Long.

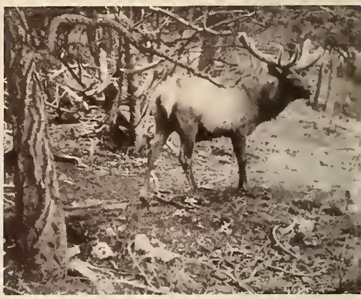
Caledonia, N. Y.

The following information is offered by Dr. John T. Zimmer of the American Museum's Bird Department:

Accusations are sometimes leveled against wild birds for supposedly killing their own young, but I know of no authentic instance of it. Young ones may be severely pecked by other than their parents when they intrude in a family gathering, as in the case of barnyard fowls and other terrestrial species. But these attacks are usually not severe enough to cause the death of the intruder, and they could hardly occur among arboreal birds. Stories of parents carrying poisonous berries to feed their young when the latter have been caught and caged are beyond credence.

When young birds die in the nest, the family life of the survivors goes on unchecked, and when the dead youngsters fail to respond to the parents' efforts to feed them, they apparently cease to be recognized as offspring and may eventually be removed with other debris in the parents' routine procedure of cleaning the nest. Even when all the young have succumbed, the old birds are likely to continue efforts to feed them for at least a short time before they abandon the nest. If early enough in the season, a new attempt to rear a family may be made, otherwise not.

What killed the young robins in the nest you describe is problematical. It is hardly likely that a brooding parent left the nest so precipitously as to have dragged out both young. It is far more probable that the birds had been left without parental protection for some unknown reason during a chilly night and succumbed to exposure. They were found in the morning quite dead but without sign of injury, and the chances are that they had died in the nest some time before they were removed by the old birds. In any case, there is no reason to suppose that they had been killed by their parents.



Bull Elk

Sirs:

This picture of a bull elk with horns in the velvet was taken last June. I first knew of the elk's presence when I was walking down a small hill that leveled off into a secluded park. The elk was lying down, and the horns were all that were visible at first. Going closer as cautiously as I could, I took a picture when he first got up. Then, by keeping trees between myself and the elk, he let me approach his clearing, and I was able to get two more pictures at about fifteen feet as he stood and posed for me. However, he appeared to be getting

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NATURAL HISTORY

The Magazine of the American Museum of Natural History

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JUNE, 1950

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You will find Natural History *Magazine indexed in* Readers' Guide to Periodical Literature *in your library*

The Cover This Month

Looking out from this month's cover is handsome Chief John Hunter of the Sarsi Indian Tribe, Alberta, Canada. Every summer, after participating in the famous "stampede" and rodeo at Calgary, the Indians move their tepees west to the Canadian Rockies resort town of Banff, where Jack Breed snapped this portrait. There the Indians put on their own show—the Banff Indian Days Celebration. Tribal feathers and finery replace the Indians' workaday dungarees, and all members of the tribe attending come forth in their brightest war paint.

The Sarsi Indian group, numbering a little over 200 members, is one of several small tribes living in western Canada. Descended from Athabascan stock, like our own Navajo and Apache, they live on a protected reservation a few miles southwest of Calgary, where they engage in farming and act as guides for hunting, fishing, and survey parties. John Hunter is one of the best known of the Sarsi and one of the most modern.

The photograph was taken on 2¼-inch Anscocolor film at 1/50th second, stop F5.6.

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YOUR NEW BOOKS

Sun in the Sky • Rio Grande • U.S.S.R.
Native Arts • Out of the Earth • Narcotics

SUN IN THE SKY

- - - - by Walter Collins O'Kane

University of Oklahoma Press, $4.00
261 pp., 91 photos, 4 maps

THE Hopi Indians of northeastern Arizona have long attracted anthropologists and writers alike, and the literature dealing with this conservative Pueblo tribe is very extensive indeed. Yet the descriptions of various aspects of Hopi culture are widely scattered in technical monographs and professional journals, most of them forbidding and inaccessible to the layman. Mr. O'Kane—who, surprisingly enough, is an entomologist—has thus performed a very real service in making available for the average reader a well-rounded, popular portrayal of the Hopi way of life.

Although the book is not addressed to a professional audience, it is obviously an honest, firsthand account, based in large part upon the author's residence in Hopi villages and his personal contacts with the Indians. As such it cannot be ignored by anthropologists; in fact, it contains some material that seems entirely new. Indeed, the treatment of Hopi manufacturers is in some respects more complete and systematic than that found in the technical literature.

A nice balance is maintained throughout between Hopi culture as it exists today and the ancient traditional patterns, now gradually disappearing. It is only natural, however, that in attempting to deal with the totality of Hopi culture, the author should delineate certain aspects more successfully than others. Generally speaking, the chapters on economic life and material culture receive more adequate treatment than those concerned with social and political organization.

The presentation is simple, straightforward, and unpretentious; yet, it leaves the reader with an appreciation of contemporary Hopi life, as well as of the traditional roots extending back into the pre-Columbian past. Although not all of the illustrations are noteworthy as photographs, they do depict some subjects that have not, to the reviewer's knowledge, been illustrated previously. It is to be regretted, however, that the author did not provide a more adequate bibliography.

H. T. TSCHOPIK, JR.

OUT OF THE EARTH

- - - - - - - - by Louis Bromfield

Harper & Brothers, $4.00
305 pp., 32 illusts.

THE science of agriculture and the art of farming are slowly fusing into a practice of husbandry that gives hope for a more productive world. This process of fusion has been accelerating in recent years, and many isolated investigations and scattered judgments are being integrated with new meanings. Louis Bromfield in *Out of the Earth* has brought many of these developments into a focus, that of the practical farmer dealing with the realities of his land, the growth of his animals, and the productivity of his crops, whose synthesis is, broadly, better living.

Nearly all of the chapters are completed discussions within themselves, possibly because many of them appeared as separate articles in journals and had to stand alone. Thus there are many ideas, statements, and phrases that are repeated many times over; but for those of us who are likely to read the book as a whole and then study it intensively in parts, the repetition is pointed and valuable.

The book is not and is not intended to be scientific in the sense of attempting to prove effects from causes or to develop inescapable conclusions from controlled experimentation. It does, however, point up the fact that all people can be intelligent in observation, imaginative in application of experimental procedures, and sane in the evaluation of results.

The chapters on the uses of organic materials, on the extension of usable soils to subsoils, on the control and improvement of the water table, on planned farm livestock economy, and on regional opportunities in husbandry have special and intensive meanings for all whose roots are in the soil, from the backyard gardener to the extensive farmer. The rest of the book, which brings a deeper understanding of the meaning of agriculture in this modern world, should be read by all who enjoy the present one and respect the one of the future.

CHARLES RUSSELL

NATURAL REGIONS OF THE U.S.S.R.

- - - - - - - - - - - - - by L. S. Berg

Translated from the Russian by O. A. Titelbaum. Edited by J. A. Morrison and C. C. Nikiforoff

The Macmillan Co., $10.00
436 pp., 81 illusts., 23 maps, 30 tables

FROM Arctic tundra to the subtropics and from land below sea level to some of the earth's highest mountains, the U.S.S.R. is one of the most varied countries. This geographic panorama has deeply influenced the characters of the peoples of the Soviet Union, and their history. It is certainly going to influence the future history of the whole world. There is, therefore, crucial importance in having available in English an authoritative and generally adequate description of the physical geography of the U.S.S.R.

This work was first published in Russian in 1936, and it is the standard treatment of the subject within Russia, itself. The author, a leading Soviet geographer, is an extremely versatile scientist, probably best known in this country as an ichthyologist. The translation is said to be scrupulously faithful to the ori-

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ginal, but it is also clear, sufficiently idiomatic, and readable in English. Special care has been devoted to the tricky problem of translating names of plants and animals. The photographic plates are not those appearing in the Russian edition but are a good selection from other sources.

Treatment is regional by zones defined climatically, topographically, and biologically. The whole vast area is divided into 20 major zones, each the subject of a chapter with systematic discussion of definition, climate, relief, soils, vegetation, and fauna, plus an occasional special heading when appropriate. Arrangement and style are those of a rather dry textbook, and the book will hardly be read for pleasure, but it is an invaluable work for reference and study.

G. G. Simpson

THE RIO GRANDE: RIVER OF DESTINY

by Laura Gilpin

Duell, Sloan & Pearce, $6.00
243 pp., 234 photos, 5 maps

THIS is a very handsome and impressive book, magnificently illustrated and written with directness and great sensitivity. As in her earlier camera chronicles, Laura Gilpin's photographs are of exceptional quality, and they portray the landscape and the peoples of the Rio Grande Valley with imagination and drama.

The book, the author tells us, is intended as "a portrait of a river with a sequence of related subjects." That it more than succeeds in this aim is evident, but in a sense it is also a photographic record of the history of the Southwest. Like all great rivers, the Rio Grande has dominated the lives of the inhabitants of its valley from the prehistoric past to the present day. Important events in the histories first of the Indians and later of the Spanish conquistadores, colonists, and Mexicans were enacted along its banks. Still later came the Anglo-American farmers, cowmen, prospectors, and industrialists. The people and monuments of the Rio Grande Valley reflect these several racial and cultural heritages as the author's camera roams the river from its source in the San Juan Mountains to its delta on the Gulf of Mexico.

The contents are divided into three principal sections, entitled respectively "The Source," "Midstream," and "The Border." In addition, a useful appendix includes a glossary, chronology, bibliography, and miscellaneous statistics concerning the river. The accompanying text supplements the photographic essay, highlighting the outstanding events of Southwestern history as these unfolded down the length and breadth of the Rio Grande Valley.

Although, perhaps, the point is not driven home with sufficient emphasis, Miss Gilpin's pictorial record reveals all too clearly the progressive desiccation of the Rio Grande as the great river approaches its delta, and points to the urgent need for additional and more stringent conservation measures.

H. T. Tschopik, Jr.

FLIGHT FROM REALITY

by Norman Taylor

Duell, Sloan & Pearce, $3.50
237 pp.

ALL "slaves of habit," whether it be of coffee, tea, tobacco, or tequilla, should understand and appreciate the title of this book. For here we have a general and lively account of some of the world's most interesting plants—chiefly those producing narcotics. The sort of "escapism" that these plants, through their alkaloids, may aid is best conjured up by some of the chapter headings: "The Pleasant Assassin," "The Abyss of Divine Enjoyment," "Come and Expel the Green Pain," "The Lively Image and Pattern of Hell."

The reader may meet old acquaintances in this volume like the ones mentioned above; in addition, appear a galaxy of unusual and largely unfamiliar botanicals including caapi and coca, kava, hashish, and peyotl. Of some of these Mr. Taylor speaks with first-hand knowledge; for the others he has digested a sizable bibliography. Of their use the author seems to agree with the Guatemalan Indian who, to explain his addiction to the alcohol of aguardiente, replied: "A man must sometime take a rest from his memory."

Some minor errors of fact have crept into this book. For example: Inca Peru included no part of Colombia but did include the northern half of Chile (p. 147); the coat-of-arms of Peru includes a llama (not a vicuña) and a cinchona tree (not a coca leaf) (p. 150); the coca shrub may attain a height of six feet, and it is very doubtful if individual cocales produce for centuries (p. 155); and there were never "ancient Caribs" in Haiti (p. 161).

W. H. Hodge

OF MEN AND MOUNTAINS

by William O. Douglas

Harper & Brothers, $4.00
338 pp.

THIS is a book of the out-of-doors, an account of the author's days spent in the mountains of Washington and Oregon. These sojourns in the magnificent wilderness of the Pacific Northwest begin as boyhood exploits and are continued as outings and spiritual refreshment in the busy life of a man devoted to public affairs.

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As a small child, William Douglas suffered an attack of infantile paralysis that threatened to leave him a cripple. His legs were weak, and he turned to exercise in the open as a systematic campaign to recover their use. How well this determination succeeded is amply evidenced by the rugged experiences he later had in mountain climbing. The town of Yakima, Washington, was his home for many years, and he was handy to an environment that developed him physically and induced a love and an understanding of nature. Whenever possible, he struck off into a primeval environment, and in his later years this habit brought not only an intimate first-hand knowledge of these western mountains, forests, and streams but periods of relaxation from human congestions and regimented behavior.

The reader of this book who is a lover of the out-of-doors (and that should include most of us) will find much to enjoy. There are episodes of camp life, glorious scenery, storms and sunshine, much about plant and animal life, and a great deal about trout fishing. The author is a keen observer; he is well-read in natural history, and he is on familiar terms with prominent naturalists. He makes the most of his hours with nature. He documents his piscatorial opinions with citations from Izaak

Continued on page 288

From the cliff statues of Bamiyan to the mysterious ghost city of Peshawarun—an expedition searching for traces of ancient man in little-known portions of Central Asia

By Walter A. Fairservis, Jr.*
Special Field Assistant,
Department of Anthropology,
American Museum of Natural History

Exploring the "Desert

An expedition is born of an idea, which in turn is begot from study. In this case the study was on the lands of Central Asia; the idea was that ancient man made his home there as well as on the Euphrates and Nile. The expedition took us to Afghanistan—beyond Khyber Pass—and revealed to our searching eyes the traces of mankind from the Ice Age to the days of the Crusades and the glories of the Peacock Throne. Our work took us into secluded grottoes, rich valleys of melons and grapes, and great deserts as remote from human knowledge as the planet Pluto. We saw the marks of mountain ice, great Buddhas carved in cliffs, strange signs on rock, the mound vestiges of prehistoric villages, the signs of ancient seas, ferns from the age of the dinosaurs, and a great city without a soul, mourning the past glories of Solomon and Afrasiyab.

The prosperous interior cities of Asia—Herat, Kandahar, Meshed, Ispahan—form a crescent enclosing a chain of deserts that are utterly removed from our world. Each desert has a name that explains something of the fate of the trader or soldier who ventured too far from the watered zones—the Dasht-i-Kavir ("Desert of Salt"), Dasht-i-Naumed ("Desert of Despair"), Dasht-i-Margo ("Desert of Death"), etc. Moistureless, cloudless, swept by winds of high velocity, and baked during an endless summer by temperatures many degrees above 100 F., a more severe bound and brake to human ambition is hard to imagine.

The red plateau of Registan marks

▲ BETWEEN THE TOWERING slopes of the ce
tral Hindu Kush, the Bamiyan Valley contai
many interesting vestiges of earlier culture

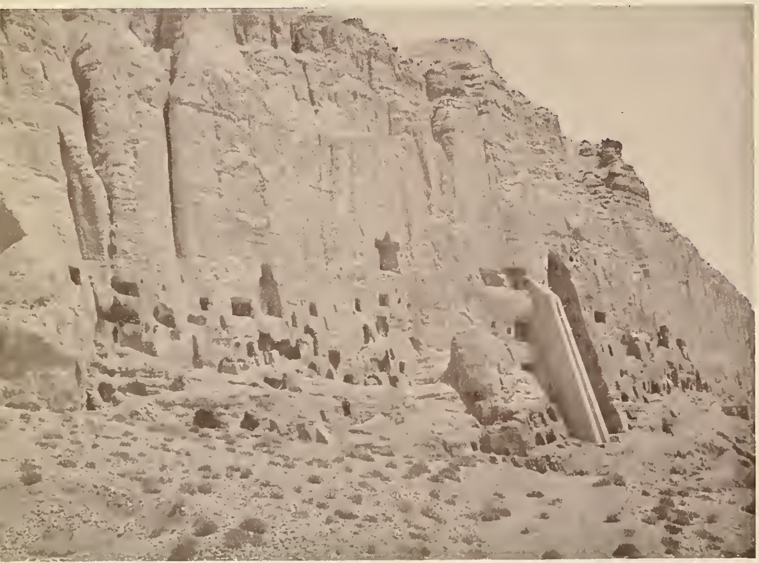

Photo by L. B. Dupree

▲ THE BUDDHIST grottoes of Bamiyan. The people who created them were fugitives who sought refuge here from persecution in India

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*Walter A. Fairservis, Jr. is the son of Edith Yaeger (Fairservis), onetime leading lady in the theater. He has worked in archaeology in one way or another since the age of nine, when he first entered the halls of the American Museum of Natural History. Mr. Fairservis received his B.A. and M.A. from Columbia University and is at present a candidate for a Ph.D. at Harvard. While he was on military service in

Photo by Fairservis

is view was taken from the fortress of Shahr-ohak, said to have been destroyed by Genghis an in the thirteenth century

f Death"

the eastern end of this haunted chain of aridity. Across it the wind blows monotonously from the west and northwest, and the air is hot and parching. Yet a river breaks into the desert chain here. The Helmand, flowing from the western branch of the Hindu Kush, cuts south between Registan and the "Desert of Death" and then turns west and north to die in the swamp of the Seistan basin, on the boundary between the Afghan and Persian deserts.

* * *

Mongolia, China, and Japan, he studied the languages of the Far East; and he recovered one of the skulls of *Homo soloensis* from the Japanese and returned it to Dr. G. H. R. von Koenigswald. Mr. Fairservis is a Special Field Assistant in the Department of Anthropology at the American Museum, and he expects to depart soon on an expedition to Central Asia to continue his archaeological research.—ED.

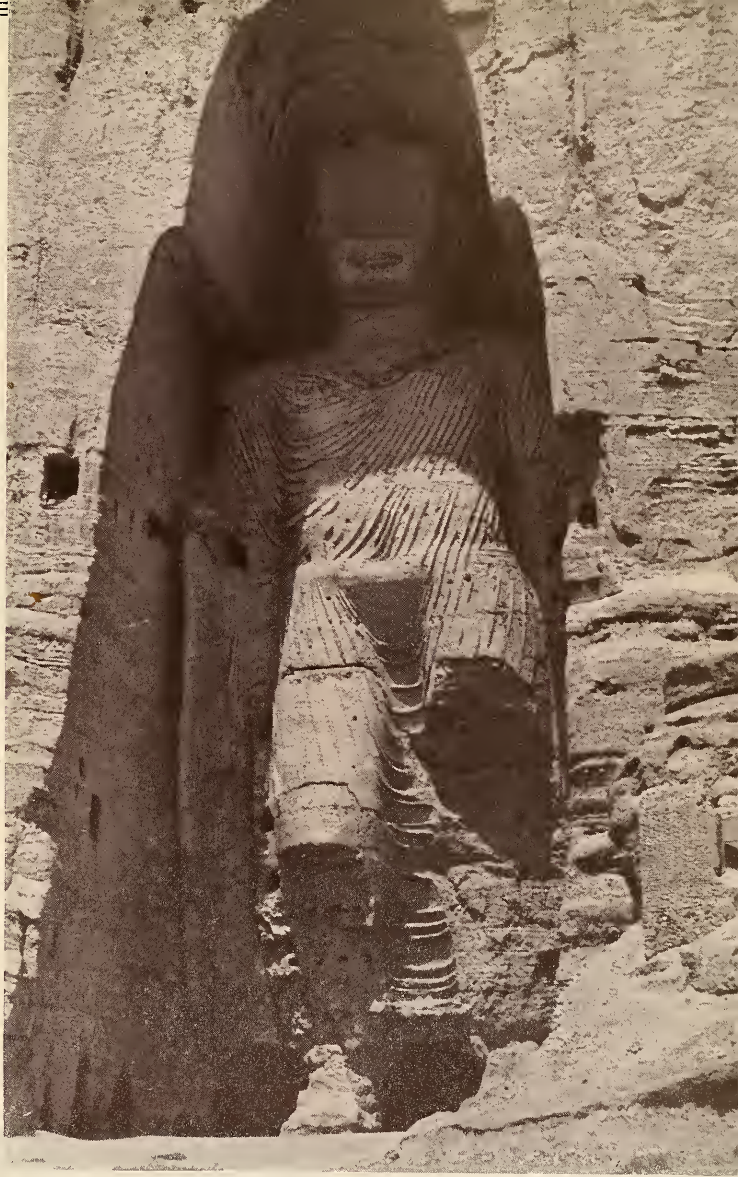


Photo by L. B. Dupree

▲ THE GREAT BUDDHA of Bamiyan: a 130-foot statue carved in the hard rock of a breccia cliff. The valley in which this and other similiar statues are found is almost 100 miles west of Khyber Pass

▼ A MEMBER of the expedition rests on the shores of the Helmand River

Photo by Fairservis

Photo by Fairservis

◄ THE CRUMBLING TOWERS of an old fort stand silhouetted against the flat river bottom that has seen armies come and go. Another view from the heights of Shahr-i-Zohak in the Bamiyan Valley

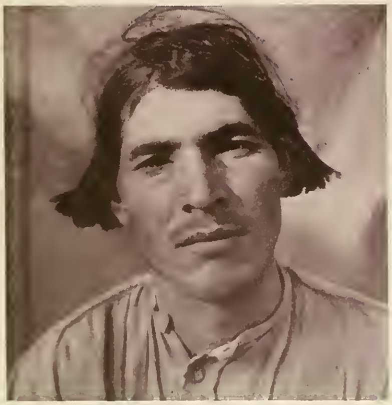
▼ UNDECIPHERED PETROGRAPHS like these are seen along the road from Kabul to Bamiyan

Photo by L. B. Dupree

This is a stream capable of upholding life along its narrow, fertile valley and at its mouth, the oasis—Seistan. Nile, Euphrates, Helmand—rivers like these, flowing through deserts, are the sole support for the people of vast regions that would otherwise be uninhabitable. The way in which a culture utilizes this essential resource of water determines the heights to which it can progress. We know very little of the Helmand, but in view of the cultures of India and the Near East we should know more.

It was with the intent to study this region that I approached Dr. Harry L. Shapiro of the Department of Anthropology at the American Museum of Natural History. I wanted to take a field party to southern Afghanistan to search for the sites of prehistoric man, which in theory should be there. Dr. Shapiro was in full sympathy with the program; and after a small fund had been raised, I left for Afghanistan with two companions—Louis B. Dupree, paleolithic archaeologist, and Henry Hart, surveyor. We met our equipment in Karachi, Pakistan, and began the thousand-mile journey to the north by way of Multan, Lahore, Peshawar, and the Khyber to Kabul, the capital of Afghanistan.

From the first, the expedition seemed shadowed by ill fortune. We had hardly gotten eighteen miles from Karachi when we found our way blocked by one of the monsoon-swollen branches of the Indus at its delta on the Arabian Sea. Fully four-fifths of the way across, the swirling water was knee-high. The last fifth, where the full anger of the flood was thundering its rage, it was waist-high! There was no other crossing, so the whole project hinged on our getting the vehicles through. If the equipment were swept down the river, there would be no expedition. I imagined myself wiring to Dr. Shapiro: "Expedition ended eighteen miles outside of Karachi!"



▲ AN AFGHAN TYPE: a hardy man over six feet tall and an excellent worker

Photos by L. B. Dupree

➤ AFGHAN WORKERS relaxing in the middle of the day. They are working for an American engineering company at Kajakai, in the Middle Helmand Valley

➤ AN AFGHAN "MILTON BERLE," who, like others of his kind, was always able to restore the expedition's sense of humor

Photo by L. B. Dupree

➤ ONE OF THE MANY mounds containing artifacts of prehistoric peoples, which the author hopes to explore further on his coming expedition

Photo by Fairservis

A motor lorry on the opposite side finally braved the flood and, with half the local population pushing, got across to us. Near by, some Pakistan farmers were trying desperately to save some cattle that were struggling in the flood. I hoped, however, that the weight of our equipment and the jeep's four-wheel drive would save the day, and so we tried. In low-low, the jeep and its trailer reached midstream, with three Americans and an English ally muttering words of encouragement as if the car were a college gridiron squad. But in midstream she stuck! Our combined efforts were useless, and for all practical purposes the First Afghan Expedition was the Last! But the local populace suddenly thrashed through the water, and wherever there was a place to push or pull, they did so. In fifteen minutes we were roaring along the desert road through the Sind on our way to Kabul.

In spite of daily tire difficulties, mechanical failures, and the monsoon, a week later we were winding along the tortuous route of Khyber Pass, about which so much has been written and so little of the real feeling conveyed. And then there was that indefinable moment of excitement when the gate at the frontier was opened and we drove into Afghanistan.

Our Western conception of the country fills it with bloodthirsty fellows who love destruction and make a career of brigandage. Yet how mistaken that conception is! We can only testify to the wonderful way we were treated on every hand. Minister of Education Aziz, though seriously ill, put every convenience at our disposal, and Mr. Ahmad Ali Kohzad, the President of the Kabul Museum, went out of his way to see that our stay was profitable. His keen interest in science was inspiring. Other high Afghan officials aided where they could. In Washington, the Afghan Ambassador, H. E. Prince Naim, was instrumental in bringing about our project, and the First Secretary, Mr. Nour A. Etemadi, was extremely understanding of our problems.

The same courteous sympathy was generally evident among the Afghan people. Proud as they are of their unconquered tradition and also filled with a not unreasonable distrust of the Westerner, they nevertheless get along very well with Americans everywhere. The Morrison-Knudsen Company, Inc., of Afghanistan, an American engineering firm under contract to the Afghan Government, has been their

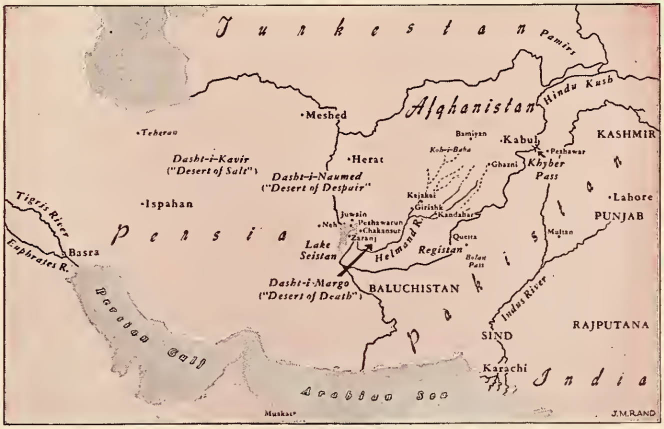

Turkestan
Pamirs
Afghanistan
Hindu Kush
KASHMIR
Meshed
Teheran
Bamiyan
Kabul
Koh-i-Baba
Peshawar
Ghazni
Khyber Pass
Herat
Dasht-i-Kavir ("Desert of Salt")
Dasht-i-Naumed ("Desert of Despair")
Kajakai
Girishk
Kandahar
Lahore
PUNJAB
Tigris River
Ispahan
Juwain
Neh
Peshawarun
Chakansur
Zaranj
Persia
Lake Seistan
Helmand R.
Quetta
Registan
Bolan Pass
Multan
Basra
Euphrates R.
Dasht-i-Margo ("Desert of Death")
BALUCHISTAN
Pakistan
Indus River
Persian Gulf
SIND
RAJPUTANA
Karachi
India
Arabian Sea
Muskat
J.M.RAND

Photo by L. B. Dupree

▲ A FRIENDLY AFGHAN who found humor in everything

▲ THE VEHICLE THAT carried the expedition across 8000 miles of desert and mountain. A typical scene at Seistan, a desolate district in southwestern Afghanistan

Photos by Fairservis

▲ A CARAVAN in an Afghan village on the road to Seistan

major source of contact with Americans. Afghans are employed in the construction camps, and Americans are now no novelty in the cities. There is every chance of friction, yet cases of it are rare.

We were helped voluntarily on many occasions both by the Afghan lorry drivers and the people of the fields. Strongly Moslem as these people are, they never let religious feeling interfere with their good treatment of us. I do not mean to gloss over the Afghans with fine words as if the country were some Asian Eden. We had difficulties, of course, with thieves, malcontents, etc., but no more than we would have had in the United States. Under the country's absolute but progressive administration, Afghanistan is rapidly taking a place in the Asiatic world, which will have to be reckoned with by all nations in the scheme of world affairs.

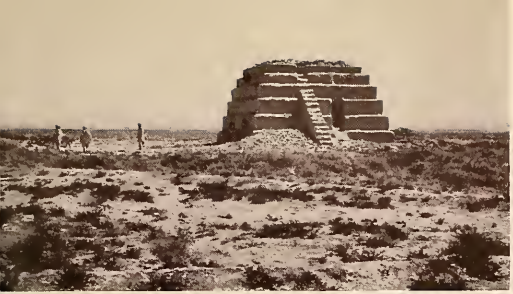
Kabul is a fast-growing city with paved streets, electric power, and plumbing. Set in a beautiful mountain valley, it is surrounded closely by high hills on which the ruins of old forts can be seen. Indications of Afghan progress are seen in the strings of lights that have been placed on these hills, ringing the city with their illumination. Approaching Kabul at night, which one usually has to do in the long drive from Peshawar or Kandahar, the glimpses of this "necklace" around Afghanistan's new "city of light" are rather breath-taking.

The peoples one encounters in Kabul clearly indicate Afghanistan's position at the crossroads of Central Asia. Mongolic Hazara, Turkic Uzbeg, Persians, and Baluchi mingle with the Kabulese. The Pathan peoples of eastern Afghanistan, who are there in large number, have been written of too often to repeat the description here, but a glimpse of their tall figure, stern face, straight nose, and piercing black eyes is sufficient to give one a hint of the spirit that has kept their mountain homes inviolate over so many centuries.

Afghanistan economy is primarily agricultural, heavily supplemented by animal husbandry. The melons and grapes of the Kandahar region are justly famous and are of high quality. The number of "fat-tailed" sheep is amazing, and it is quite ludicrous to see these unusual animals waddling hurriedly across the road with their fatty hind appendage acting as a brake to their progress. Long-haired goats mingle with the sheep, and their browns and blacks are quite striking. Camels are seen in great abundance, and no matter what the temperature or the hour, the sight of their flopping lower lip, disconsolate eyes, "cloth" ears, and rather inarticulate body restores one's sense of humor instantly.

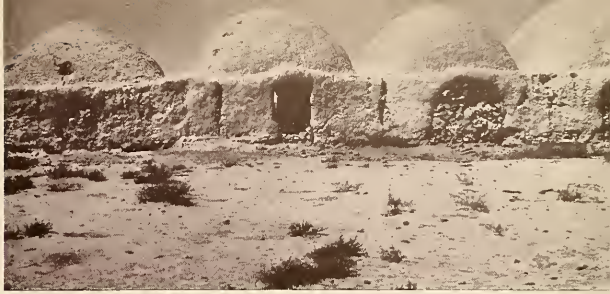
Whereas in the past Afghan agriculture has been limited to a few crops, recent emphasis on land reclamation through irrigation has instigated experimentation. The possibilities of growing a major staple crop such as cotton are very good, and a gradual revolution in Afghan economy could well take place with the irrigation of these hitherto arid lands.

After final arrangements had been made, our expedition set out for the Helmand Valley and the beginning of our intended task. The route we followed out of the mountains was a very ancient one, an alternate road to India via Ghazni, Kandahar, and ultimately the Bolan Pass of Baluchistan. However, at Kandahar we went westward toward Girishk instead of south to Quetta in Baluchistan. On the evening of our second day from Kabul we had reached the river and proceeded south on its western bank until our progress was blocked by the dunes



Photos by Fairservis

Possibly an ancient granary in Seistan. It resembles a
aldean sacred tower, though it is 1000 miles distant



▲ Beehive-shaped houses on the Perso-Afghan frontier near Lake Seistan

and wadis of the Dasht-i-Margo.

The Helmand at Girishk is several hundred feet wide in summer but at least three times that in spring. The valley it has carved out is several miles wide in places. South of Girishk, the people live down along the flood plain, most of which is irrigated or covered with tamarisk. This flood plain abuts against the boulder-conglomerate bluffs of the desert, and we had to travel on these bluffs because of the brush and irrigation ditches on the flood plain. The high wind that blows from the west across the desert has blown out the sand of the surface, leaving only the large boulders. They are almost cemented into position by chemical and thermal action and present an exceedingly hard surface of black pebbles. This is the process known as "armoring the desert," and, in fact, it would take the best of modern equipment to crack this natural armor. Our vehicles ran smoothly over this surface at speeds up to 50 miles per hour without difficulty. Ancient erosion, however, has carved ravines, or wadis, out of the desert. The sand has found refuge in these, and each system constitutes a trap of the worst sort for the unwary driver.

Trying to get a vehicle out of one of these traps is a nightmare worthy of a Poe or a de Quincey. The wadi's walls prevent the wind from cooling one's body, and the direct rays of the sun, unbroken by clouds or haze, pour mercilessly on the men working to free the vehicle. On one occasion it took us four hours in the heat of the day to get free of an innocent-looking patch of white sand. Four-wheel drive, bracing, canvas, wood flooring, etc., were of no avail; only the combination of shoveling and ardent pushing did the trick. Being far from gasoline sources, we could not afford to skirt the many miles of wadis, so in order to stay within range of the river we were exploring we had to take certain risks in crossing them.

These ancient river systems, in carving out their pseudo basins, have left high walls and bluffs in places. As the desert horizon is usually almost mathematically level, seeing these bluffs is a definite relief. On one occasion we had with us an Afghan boy, Olam Nabi, who spoke three languages: Pushtu, Persian, and Baluchi. He had been extremely helpful, especially in gathering fresh fruit and eggs for us. As we were driving south one day, he pointed to the west where the vast expanse of the waterless waste of the "Margo" spread its heated surface. To our amazed eyes we seemed to be gazing at the walls of a great city, beyond which could be seen towers and buildings. The nearer we approached, the more our first glance was confirmed. Suddenly we all recognized the "city" for what it was—simply the bluffs of our well-known wadi-basin system. It was neither a mirage nor a trick of the mind, but our eyes, so accustomed to the monotonous horizontal, had conjured up dwellings when the horizontal was broken.

Our survey along the river confirmed the belief that this part of Central Asia had been unglaciated during the Ice Age. For this reason, it may well have been a haven for ancient man. The mountains that prevent the Indian monsoon from bringing moisture to southern Afghanistan must have performed the same function during the Ice Age, with the result that the unnourished mountain glaciers could not have devoured the lands to the south. The extent to which ancient man utilized this ice-free area is as yet uncertain, since we found no actual artifacts. However, future search of the region should confirm his traces—traces that were only hinted at in this first brief survey.

Just before our departure from Afghanistan we were told by Mr. Morris Brown, an engineer, that there was a valley near Kajakai, in the foothills of the Koh-i-Baba, whose rocky slopes were covered with strange pictures of animals and figures. We were naturally eager to visit this place. After swimming the Helmand and climbing through a break in the cliffs, we entered a narrow valley several hundred yards in length. One glance confirmed Mr. Brown's description. Not only were there numerous animal and human figures but a wealth of strange, undecipherable signs as well—checkerboards, human hands, loops and circles, and even a figure that suggested nothing other than an octopus! These were pecked out of the rock in no particular order. Many of them were exactly like those seen by the Russians in the Pamirs. We had also seen similar ones on the road to Bamiyan, the ancient center of worship in Buddhist times. As to who made these drawings, and when and why, we have no answers as yet. Petroglyphs have been cut by man in extremely remote antiquity and carried over into modern times. Many of the animal drawings were probably made to bring success in hunting. A high percentage of signs were probably used as amuletic devices or cabalistic tokens. The similarity of some of them to certain ancient alphabetical symbols may aid us in understanding these glyph-pictures, as will their relation to conventional art forms and religious symbols.

Having completed our reconnaissance along the middle Helmand, we proceeded into the Seistan region of Afghanistan, which lies along and over the frontier of Persia. We set out along the foothills of the Koh-i-Baba and headed westward. Approaching the Persian frontier, we turned south of the main route at the cool tree-studded city of Farah. The road, an old one that led from Herat into Seistan, is now used by occasional motor lorries en route to Chakansur.

We passed our first night in Seistan on a bank beside this road, where a low mud wall provided protection from the northwest wind. As we proceeded southward, the wind seemed to increase in violence until "puffs" of 60 miles per hour were a daily occurrence. This is the famed "Wind of 120 days," which starts in May and blows well into September. Velocities up to 110 miles an hour were recorded by the British on the Perso-Afghan Boundary Commission around the turn of the century, and at no time did we encounter a velocity of less than 20 miles per hour. The wind is a curse and a blessing at the same time, for the temperature of the day becomes almost unbearable, varying from 105 degrees F. to as much as 125 or 130! This makes the ground so hot that at night the thermometer rarely falls below 75 degrees. The wind, however, by drying perspiration, makes these temperatures somewhat more tolerable, even though quantities of sand are whipped up constantly and the tiny grains penetrate everything, whether it be carburetor or eye.

In spite of such discomforts, the trip into the Seistan basin was most profitable. At every hand we encountered evidences of archaeological interest. Over 35 mounds, or *tells*, were located, and surface collections were made at most of these. Our laboratory studies have since revealed pottery fragments of the prehistoric period, enabling us to date a number of sites as belonging to that period. Excavation of some of these sites is planned for the coming season, and much significant material should be recovered. Thus, our primary objective in entering Afghanistan was achieved in a way that was most gratifying.

One blazing-hot September day we were amazed to see the ruins of a large city on the horizon. It might seem impossible to encounter such a thing in the desert, but the ruins continued for nearly six and a half miles! Drawing closer, we saw the remains of palaces, mosques, and homes. The wall that had protected the city was in some places in a startling state of preservation; in others it was in complete ruin. The reader may recall having read of this "Ghost City" in the newspaper accounts of our expedition—a desert metropolis standing mute just as it had for six centuries or so since its abandonment, undisturbed except for the ravages of time.

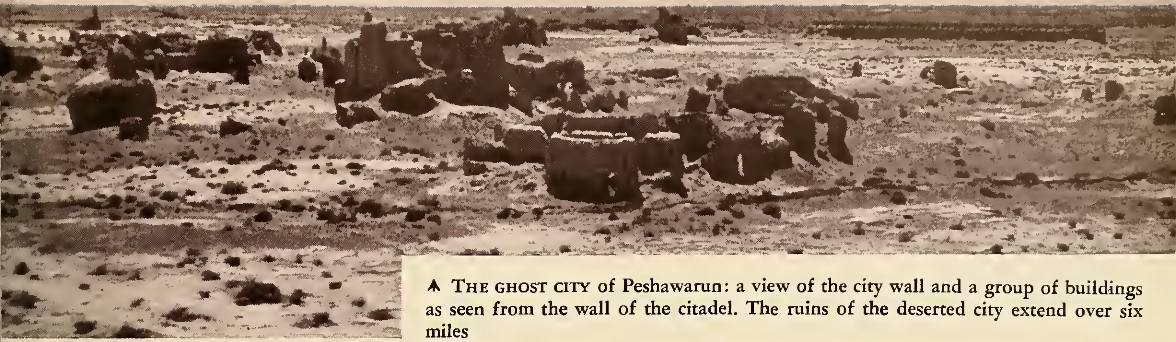
We knew from the works of Sir Frederic Goldschmidt, A. H. McMahon, Ellsworth Huntington, Sir Aurel Stein, and others that Seistan was literally covered with the ruined cities of the Medieval Islamic period (A.D. 1000-1500), as well as earlier sites. Many of these cities, such as Zaranj and Neh, were of some importance during the "Golden Age" of Islam. This one—Peshawarun—some 40 miles south of Juwain, had been mentioned in various reports but never fully described.

Our program did not permit us to devote time to Islamic studies, but we could not pull ourselves away from these ruins, so well preserved were they and so dramatically eloquent of the effects of climate on a city. Failure of the water supply seemed a logical explanation of the fairly sudden abandonment of Peshawarun. We found wells of considerable depth bone-dry.

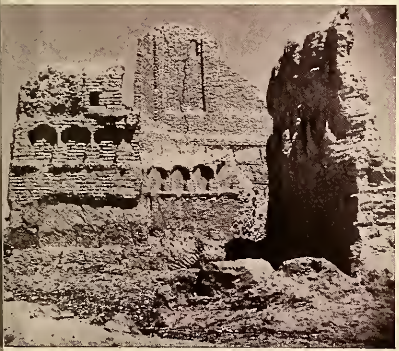
To drive between the walls of great buildings to the base of the fortress that dominated the town and to see not a living soul was an exceedingly strange experience. Everywhere there were signs of extensive irrigation, showing that the land had once been highly cultivated. In fact, from the size of the buildings and the extent of the city area there can be no doubt that Peshawarun must have been an important center and the home of a considerable population. The records we have seen tell us nothing of its history. There is a local legend that when Tamerlane punished Seistan, he destroyed the wells and thus forced the populace to flee over the deserts and mountains to found the modern city of Peshawar at the eastern head of Khyber Pass. There is no evidence either for or against the legend, but it should be recalled that a great percentage of Eastern disasters are attributed to either Genghis Khan or Tamerlane without historical confirmation.

Whatever effect Tamerlane may have had on the city, the fact remains that Peshawarun was never reoccupied. However, there is a small native village only a few miles away, where water is drawn from a well over 60 feet deep. One immediately wonders whether something caused the water table to lower so much that occupation of the city could not continue. Even if there had been conquest or plague, it is difficult to imagine a large populace giving up a fertile area completely and permanently when such areas are at a premium. I believe the answer lies in the antics of the Helmand River, which, in flowing into a shallow basin delta, changes its course at will. Movements of this sort affect the level of underground water, and thus the cause may be partly physiographic. But the Helmand shift can be due to numerous causes, and especially important may be rain failure in the Koh-i-Baba.

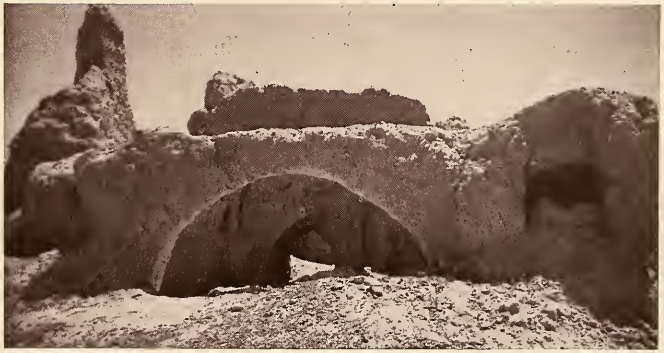
Whatever the cause of the city's abandonment, there is something pointed up in Seistan that is more significant than the story of a single city of the Islamic period. Seistan presents a forceful picture of the effects of geography on the workings of man. When nature forces



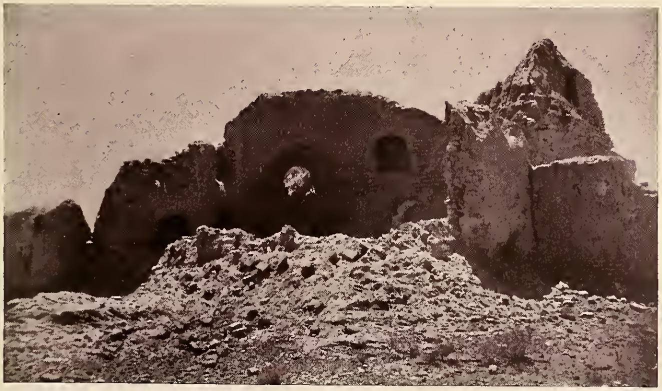
▲ THE GHOST CITY of Peshawarun: a view of the city wall and a group of buildings as seen from the wall of the citadel. The ruins of the deserted city extend over six miles



▲ ONCE AN IMPERIAL PALACE, now a symbol of Peshawarun's vanished splendor



▲ WHEN PESHAWARUN was a thriving desert metropolis, the sound of commerce and government echoed in these arches, now half buried



Photos by L. B. Dupree

▲ A RUINED ARCHWAY in the citadel wall at Peshawarun

◀ ANOTHER VIEW of the ancient palace at Peshawarun

man to do something, it may come as a shock to the psychology-permeated cultural anthropologists of the present day, who would hitch so much to the multifaceted personality of *Homo sapiens.* Migratory studies are of vital importance if we are to perceive the workings of history as well as some of the mechanics of cultural diffusion. In Central Asia the effects of desiccation are extraordinarily clear, and the need for the proper approach to this problem of man and nature and his culture is very great. As yet, we can only guess at the factors concerned.

Central Asia forms a huge stage on which lie the clues to many aspects of mankind's ancient past. Out of its desert lands have come some of the greatest intellectual and spiritual developments in all history. Perhaps on this stage the clues to be found in lands like Afghanistan will crystallize still more for us the drama of our heritage of conscience as well as of culture.

In June we leave again for Afghanistan to search further into these unknowns.

Cherished

By canoe and snowshoe in a primeval wonderland w

"BUT of all the wildernesses that you know," people say to us, "you cherish most your canoe country. *Why* do you love it most? Why have these friends you speak of been willing to give years, sometimes their entire lives, to preserve its wildness?"

I will try to answer those questions.

First, we, and many many others, love this canoe country because it is truly a solitude. It is not overrun with people as are many of the accessible wilderness areas. Instead of a few roads or trails on which you must meet all visitors, you may travel in your canoe in any direction, and yet you do not need a guide—only a good map. So you have the joy of seeing a true wilderness with utter freedom.

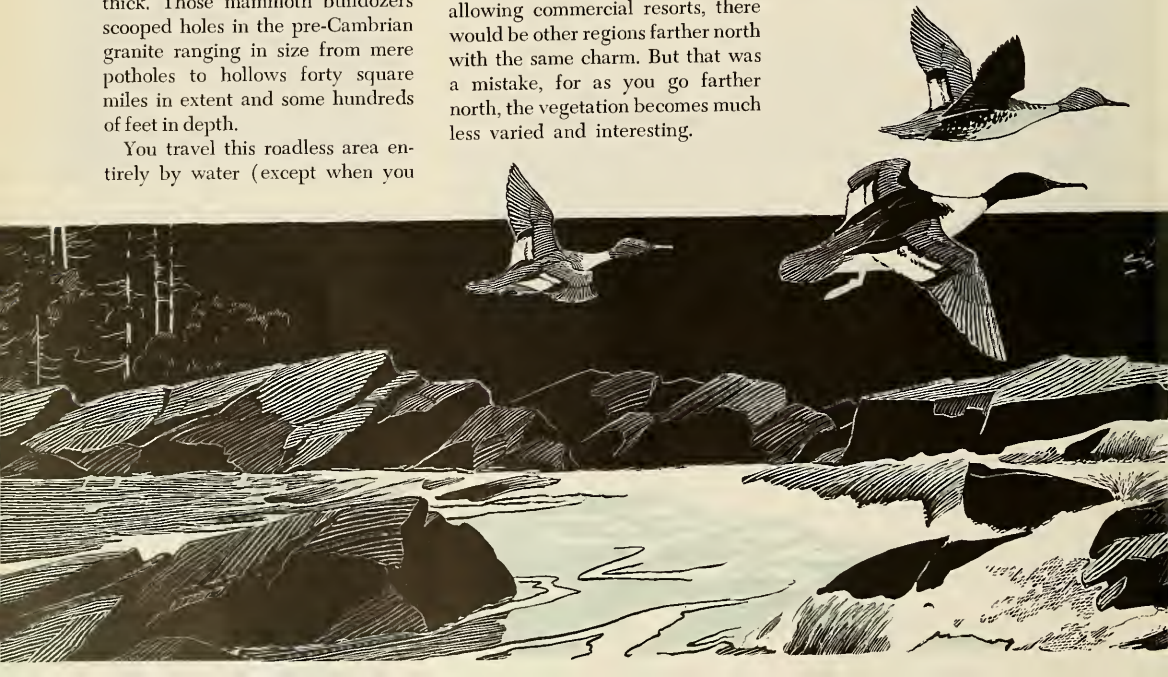
This area, the Quetico-Superior, lies on the borders of Minnesota and Ontario, between Lake Superior and the Lake of the Woods. It is hardly limited in space, being about 175 miles long and containing around 16,000 square miles. It is a maze, a labyrinth of countless lakes, tied together by rivers and channels—in fact, 40 per cent of the surface of this land is covered by water. These lakes were made in the recent Ice Age by glaciers more than a mile thick. Those mammoth bulldozers scooped holes in the pre-Cambrian granite ranging in size from mere potholes to hollows forty square miles in extent and some hundreds of feet in depth.

You travel this roadless area entirely by water (except when you make a portage) just as the earliest travelers did. Airplanes will soon be banned from flying over the area, to the great relief of its devotees, so that there will be no danger of finding the ancient peace shattered by a sudden onslaught of the motorized era! It is practically uninhabited, and as you journey through it, it looks as it did to the Indians and voyagers in the early days. It is possible to canoe for days without seeing other campers.

In the second place, we love the region for its sheer beauty. To enter it is to enter a forest realm of unspoiled loveliness. With lake after lake of blue lucidity, it does not matter where you choose your way, for a fresh beauty is everywhere. And such diversified beauty! I once thought that if this country were spoiled by changing water levels or allowing commercial resorts, there would be other regions farther north with the same charm. But that was a mistake, for as you go farther north, the vegetation becomes much less varied and interesting.

Here are lakes of purest clarity, streams quiet or wild with white water. Here are forests of pine, of spruce, of aspen, birch, and other hardwoods. Great granite cliffs, deep in moss and ferns, tower above, and marshes stand thick with reeds and wild rice. Here are bare, stony hills, rapids that rush by shadowed ledges, sandy beaches. Here, best of all, are hundreds and hundreds of big and little islands. Once the tops of craggy hills, they are survivors of the Ice Age—low ones of smooth-washed stone, and rocky heights black with pine.

And it is just as inspiring to the other senses, all of which seem suddenly to awaken. As you take a portage trail through the dense spruce, you are vividly, not dimly, aware of its resilience underfoot, of the scent of the pungent sweet gale leaves,



derness

nature lover will want to see preserved—

the Quetico-Superior area, whose beauty hangs in the conservation balance

By Florence Page Jaques *Illustrated by* Francis Lee Jaques[*]

and the poignant song of the hermit thrush, while at the end of the trail you may be refreshed by the taste of the clear water you dip from any lake or stream.

Memory brings back the smell of campfire smoke, sun-warmed pines, and damp muskeg; the taste of bass, freshly caught; the sound of a deer's whistle or the slow plunge as a moose leaves the water, and the never-forgotten loon call.

The greatest boon of all, however, is to listen to the profound silence. You cannot realize how frail most silence is until you experience this, so deep that you can trust your whole being to it, sure of its strength.

Then there is the enjoyment of physical effort. The mere breathing of the stainless, heady air; the exhilaration of paddling, drifting down glassy water or fighting furiously against a head wind. Because of the rocky terrain, making camp is seldom difficult, for there are innumerable sites to choose from. Portages are most enjoyable, if they are short ones and if you make them easy by walking across two or three times instead of lugging everything at once. The shadowy walk itself is a welcome change after the hot sun or boisterous wind over the water—if you aren't staggering under too heavy a load. Fishing is excellent in many of the lakes.

All these experiences we savor to their full because of the way we travel here. We are all dashing through the present world so fast we scarcely have time to see it. But in these primitive fastnesses all our senses have a chance to come fully into play.

I have to admit to a naive astonishment when I discovered that this country had as great beauty in winter. After our *Canoe Country* was published, the University of Minnesota Press gave us a fellowship so that we could get the material for *Snowshoe Country.* We were to stay in the same territory in the winter-

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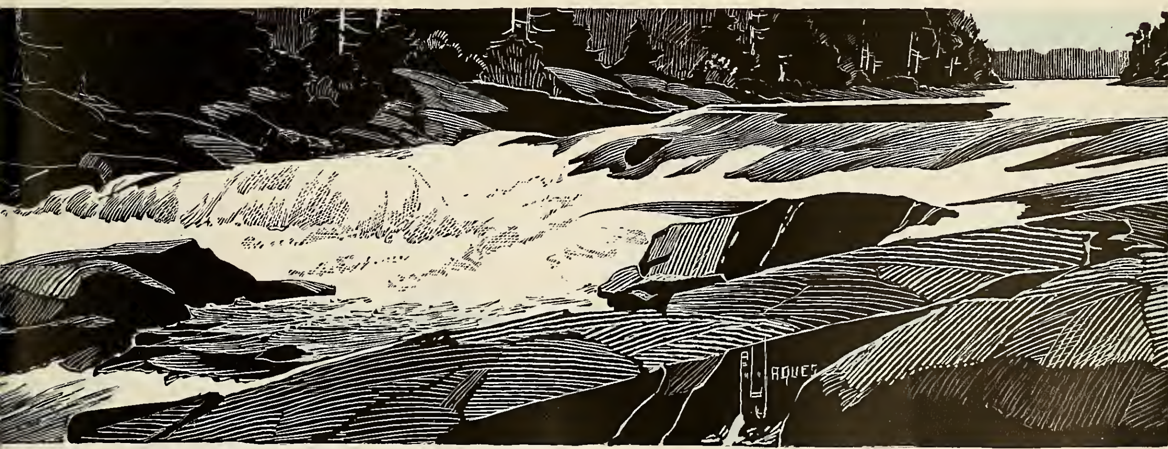
[*] Florence Page and Francis Lee Jaques hardly need an introduction to the readers of Natural History, for many of their interesting and beautifully illustrated books have been reviewed in this magazine. *Birds Across the Sky, Canadian Spring,* and *The Geese Fly High* were written by Mrs. Jaques and illustrated by Mr. Jaques. In 1946, they were jointly the recipients of the John Burroughs Medal.

Mr. Jaques, one of the world's most distinguished bird artists, worked at The American Museum for many years, where he painted many outstanding panoramic backgrounds. He has accompanied expeditions to the Arctic, the Polynesian Islands, Panama, and the Bahamas.—Ed.



time. Because I had always dreaded cold weather, I was simply horrified at our good fortune.

I never once thought of refusing it, but I expected the worst. It was, however, one of the most rewarding experiences I ever had, and I would do it again any time I had the chance. Of course, we didn't camp; we stayed in a small cabin on the edge of the roadless area. To my surprise, a small stove made from an oil drum kept us perfectly warm indoors, blizzard or no, and I found that, dressed in layers of wool, I was more comfortable outdoors in 30-below-zero weather than I had sometimes felt on a sticky August day. I even found that in my ski suit I could rest, lying in a snowdrift, while I watched a pine grosbeak sing or a shrew dart hither and thither, and feel as much at ease as if I lay on a sand dune. For a while, at least.

And the glory all about us was unbelievable. Deep snow covers the country the entire winter. I had thought there might be a monotony about such a continually white landscape, but it was never just white. There was a continual play of color about us. The apple-green skies might reflect in the frozen lakes, or a bright sun would change the shadows on the snow to vivid blue or strong violet. Evening light might touch the snowy hills with gold and the morning with clear shell-pink or lavender. We had stormy sunsets of scarlet and purple beyond snowy pines, and we had northern lights of such strange hues I could not recognize them. Hoarfrost might be so thick upon the scraggly aspens in the morning that they looked all aflower with silver. I had thought that if the winter dragged we could always escape to Duluth for a few days; I never even remembered that idea after we were in our cabin.

The winter sounds I remember even more distinctly – the deep clangs, like those from an enormous gong, which the lake gave, and the crack of branches in the coldest weather, and the uproar the sled dogs made late at night when a wolf or a fox barked. Whenever I now hear the spring song of the chickadee—those two little notes like a miniature phoebe's—I think of a warm January day on the Gunflint Trail. And there is the faint *shushh* when a drift of snow slips from the laden branches of a spruce. I sometimes put myself to sleep remembering the nights when we walked on snowshoes along the trail before we went to bed; there would be that *shushh,* and then a deer might bound across before us in the dim snow light and disappear in the black forest. Yes, we appreciated the country in winter, too.

But most of all, I am sure, we love the canoe country for the release it brings us from our complex modern existence. This is not an escape from reality—in fact, it is an awakening to what *is* reality. The canoe country gives us the joy that should be man's heritage.

We are released from possessions. And how exultant we feel when we arrive at this simplicity—to start off in a fragile shell (for a canoe is the most trifling barrier from nature imaginable) with all our worldly goods in a few packsacks, with no need for immense mechanisms or complicated contrivances to aid us on our way, with only sturdy paddles in our hands.

We are released from time. Imagine having no need for a watch, having no appointments or schedules. There is no hurry, for as each square mile of the many thousands is rich in interest, why rush anywhere? On the other hand, if we have a desire to wander, we do not need to wait for a train or a boat to start or a gas station to open.

Suppose we have had a lazy, rainbound day and have gone to sleep in our sleeping bags immediately after an early supper. Suppose we awake sometime long after midnight to find that a full moon is flooding the lake with brilliance and that fantastic pine shadows lie black on the shore beyond our small tent. There is nothing to prevent us from breaking camp and starting out through the night into a silvery and silent world. So silent that we not only do not talk but put our paddles into the shining water with meticulous care. The moon leads us on, pines stand jet-black in mysterious ranks on either shore. What eyes are looking at us from those inky depths? Far off we hear the hooting of a great horned owl.

We come to a moonlit river, where white stones gleam in faintly rippled water and bulrushes look as if they had been dipped in quicksilver. Something slips away down the water, leaving a sharp-drawn wake. Then we come to a density of overhanging branches where the night lurks blackest.

As we emerge into another wide lake, there is a hint of dawn in the eastern sky, and we watch as the faint rose light gradually gains victory over the silver. We hear a single whitethroat, then silence and darkness again. After an interval, a loon laughing wildly somewhere down the lake brings the true dawn. We find that we are ravenously hungry and stop on an island for a hearty breakfast among its jack pines.

Or we may be intent on reaching a river where we hope we may find moose. But when we come to a crescent of sand beach, why not see what tracks are there? And while we're there, why not go swimming? So we do. Then we decide to fish, after which we climb on clean mats of pine needles to a hilltop for lunch and decide it is too delightful a day not to swim again, so we make camp, even if it is only early afternoon. We may spend several days there, or we may go on to the moose river early the next morning. No one minds.

We are released, too, into a wider acceptance of companionship, when, as Wordsworth says,

With an eye made quiet by the power
Of harmony and the deep power of joy,
We see into the life of things.

We discover ties of comradeship with the animals and birds, even the plants that share this region equally with us. Here they are not under tolerance. This is their land. They have as much right as we, or more, to this domain.

So when we make camp under the horizontal branches of a white pine, we feel a companionship with it. In an unexpected October storm

the scarlet of bunchberries through the snow has seemed as warm a welcome as children might give us. And we hail the deer we encounter, the flocks of young mergansers, the exuberant pileated woodpecker, as long-loved friends. To my surprise, I become very fond of porcupines. Somehow a porcupine swimming is a rather touching sight, and when I see a small one eating leaves and swinging gaily in a thrashing treetop, I almost want to join him. Even more surprising is to begin to care for wood mice, who are really entrancing neighbors though they may annoy you.

I never think of being isolated here. I feel the release from the heavy weight humanity now carries, rather than loneliness. How could we be lonely? We meet new friends all the time.

Once I was lucky enough to see the purple finch giving his courtship dance. I had not known that a small songbird gave such a performance. In his vibrating intensity, he would have equaled the birds of paradise we once saw in their courtship at the zoo—if his feathers had been as long! Clad in brilliant rose, he danced up and down a small log before his ladylove. He turned about and about, with his crest high, raising his wings and quivering them so rapidly that they blurred into rosy radiance. Then he sprang into the air and sang in flight as if he were trying to be a rose-red skylark, before he returned to dance on the log once more.

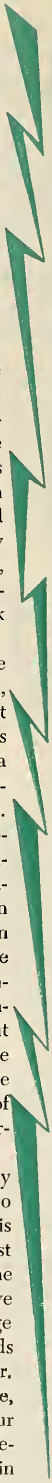
Another morning two loons permitted us to drift up to them, until we were hardly more than a paddle's length away. We were highly flattered, but we couldn't understand why such wild birds as loons would continue to let us float in company with them. We were so close we could see every detail of their black-and-white plumage, even the clear red iris of their eyes. Finally Lee spotted their nest on a hummock in the marsh close at hand, and we understood their lingering.

I treasure the memory of an autumn day when we were exploring along a shore. Golden aspens were reflected so perfectly in the dark water that we seemed enclosed in a spangled net, and I felt bewitched, as if our canoe were floating in the air in the center of this gold shimmer. To add to the strangeness, when we came round a point of rock and saw a bear facing us, it made no effort to run away as a bear should.

To look straight into the eyes of a black bear a few yards away is an odd experience. The bear gave no start of alarm and neither did we, but there was not the accord one feels with a deer in such a situation. For a moment before the deer realizes that you may be a menace, there is an inexplicable bond as its eyes encounter yours. There is no such bond with a bear! Its look changed from curiosity to disdain, and my look, if not Lee's, to apprehension, as the animal shifted feet before leisurely strolling off into the thick bushes.

Then there was the day when we had battled across a wind-tossed, white-capped lake and, tired but triumphant, came into a cove. As we floated up to shore, we saw a spotted sandpiper with her two minute babies, probably just hatched. She ran for shelter, calling peremptorily. One baby was an old-fashioned infant and obeyed mother instantly, but the other, a modern child, paid no attention to her stern command. It came out to the shore to look us over, living up to its family nickname by teetering its nonexistent tail. Such a scrap of life; but it met us on equal terms. We felt we had been congratulated on our safe arrival by a reception committee of one, and we appreciated the courtesy.

These are some of the reasons why we have such a passionate desire to see this region kept unspoiled. It is a unique treasure which we trust fervently may be preserved for the generations to come. If I could save any part of our physical heritage unchanged, it would be the woods and waters of the Quetico-Superior. For ever since I first went there, whenever I chance to think of our canoe country, an inexpressible delight and peace flood through me in a great tide.



An
Electrica
IN

A strange cold "fire" seemed t
descend on the region, and fo
a time every bush became luminous beneath the lurid storm-sk

In early September of 1949 I had occasion to drive from Madison Junction to Mammoth Hot Springs in the Yellowstone Park, and dusk was gathering when I drove onto the stretch of straight highway that parallels Swan Lake. A violent electrical storm was centered over Electric Peak, extending several miles eastward into the Beartooth Range. Heavy bolts of lightning frequently stabbed downward, and the clouds themselves seemed to be constantly flickering with an orange light. The display was so spectacular that I pulled off the road near the north end of Swan Lake and stepped out of the car to watch it.

It was then that I noticed a bluish light coming from over the low ridge to the west of Swan Lake. My first thought was of a fire, perhaps caused by lightning. I watched the ridge for a moment and was amazed to see what can best be described as a hazy patch of blue light coming over the ridge and moving down the hill slope toward the flats around the lake. It was then that I observed a very low lead-gray cloud moving swiftly above the patch of light. The patch moved through the marshy north end of Swan Lake and caused several waterfowl to rise in hurried flight.

The patch of light moved off the

Bath"

ELLOWSTONE

By

WILLIAM B. SANBORN

Park Ranger Naturalist

Photo by David de L. Condon

▲ SWAN LAKE, across which the electrical display moved before passing up the valley toward Electric Peak, in the background

lake and onto the flats at a steady rate and proceeded directly toward my viewpoint. When the patch was but a few yards away, I noted a sudden calm in the air and a marked change in temperature, as well as what I believe was the odor of ozone. It was then that I realized that the display before me was some manner of static electricity, comparable perhaps to St. Elmo's fire and directly controlled by the low cloud moving above.

The patch, which actually was a static field, enveloped my immediate area. To describe the weird feeling caused by viewing the progress of this phenomenon is difficult. It kept low to the ground, actually "flowing around" everything that it came in contact with, coating it with a strange pulsating light. Each twig on the sagebrush was surrounded by a halo of light about two inches in diameter. It covered the automobile and my person but did not cover my skin. There was a marked tingling sensation in my scalp, and brushing my hair with the hand caused a snapping of tiny sparks.

The most unusual aspect of the disturbance occurred when I threw a rock along the ground in much the way that one skips a stone over a pond or lake. Every time the rock hit the ground or a piece of brush it gave the appearance of "splashing." The light would momentarily disappear from the contact spot but immediately build up again. I noted that the static could be brushed off the car surface, and it also would establish the light again in a matter of seconds. I obtained no shock from touching any object on the ground or the outside of the car.

My estimate of the speed of the disturbance was about three or four feet a second, or faster. The field seemed to be about 50 yards wide and perhaps some 250 yards in length, roughly comparable to the low cloud above.

I watched the display move quickly up the valley toward Electric Peak until it faded from view and darkness closed in. (It might be mentioned that Electric Peak derives its name from the electric storms that frequent its heights and the surrounding region. It is the highest peak in the northern part of the park.) Upon getting into the car and closing the door, I touched the horn ring and was rewarded with a most substantial shock, the effect of which caused numbness in my arm for several hours. Probably the car had become charged negatively, since it was insulated from grounding by the tires. I must have carried a positive charge from my contact with the ground and the disturbance.

When the experience was described to Ross Gunn, Director of Physical Research at the United States Weather Bureau, he commented that phenomena of this sort are reasonably common in mountainous regions during periods of thunderstorm activity. "Usually the described effects," he commented, "are short-lived and precede a lightning discharge. The glow results from ionization induced by a highly electrified cloud overhead. The electric field necessary to produce an observable glow usually exceeds 2000 volts per centimeter. It is entirely adequate to make one's hair stand on end. In the described case, the overhead cloud was doubtless millions of volts above the potential of the ground. It is a very interesting instance of this sort of occurrence because of its great length and apparent stability."

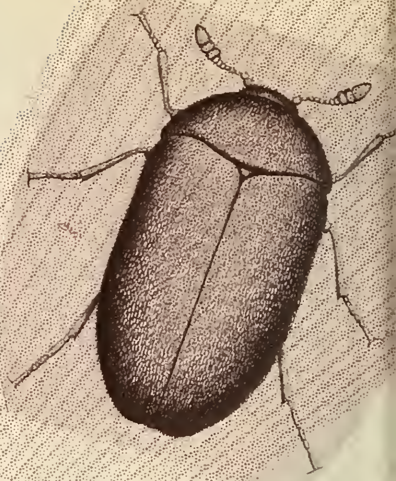
I don't know whether I would have been able to observe events as carefully as I did if I had known that it was "millions of volts," but in any case I shall certainly remember the experience for a long time as one of the most outstanding displays in nature that I have ever observed.

Carpet Beetles

Can you tell the damage they cause from that of the less destructive clothes moth? And do you know how to control their depredations? Here are the answers

By C. H. Curran

Curator, Department of Insects and Spiders,
American Museum of Natural History



AMNH photo

▲ Spraying with a one per cent emulsion of DDT, Chlordane, or deodorized Benzinehexachloride offers good protection against carpet beetle larvae. For effective control, plan on two gallons per room, with two or three sprayings a few days apart

At almost any time during the year, but especially during the warm months, you may notice on your window sill some chunky, brightly ornamented beetles about one eighth of an inch long. If your eyesight is good and you happen to enjoy beauty in color arrangements, you will stop to admire the little creatures. If you have a magnifying glass, you will discover that the color pattern is due to the presence of tiny scales of different colors; and if you examine several beetles, you will find that the color pattern is almost the same on all of them.

Should you touch one of these beetles, it will immediately draw in its horns and legs and play dead. Often it will remain quiescent for two or three minutes and can be admired at leisure. But don't admire it too much, because it is one of the carpet beetles, and its offspring are likely to cause you anguish and perhaps a great deal of expense.

There are a number of kinds of carpet beetles, and most of them specialize in a particular type of destruction. Some prefer carpets, others like the inside of furniture, some are inveterate wanderers and chew up things in unexpected places. The larvae of all of them (and these are the things that do the damage) lurk in dark places

THE BLACK CARPET BEETLE has boarded ith man in almost every part of the orld, but in the United States its larvae ause more damage than any other houseold pest

◄ **LARVA** of the Black Carpet Beetle (enlarged and natural size). It feeds on almost anything of animal origin, but woolens are its favorite meal

Photos courtesy Dominion Dept. of Agriculture, Ottawa

and are seldom seen—at least until they have ruined clothing, blankets, socks, furs, or almost anything made from animal matter. Even skins, hides, and many kinds of foodstuffs may be eaten. Because of their furtive tactics, they do not receive nearly so much blame as they should. Indeed, a great part of their damage is charged to clothes moths. Actually, clothes moths are relatively small fry compared with these beetles. Once a clothes moth larva begins to chew on something it stays put, but not so the carpet beetle larva. If it becomes dissatisfied with what it is eating, it will wander somewhere else, picking up choice morsels as it goes. Once established, the carpet beetle is difficult to eradicate.

The adult beetles generally like to get out-of-doors, where they can feed upon the pollen of flowers, which is apparently all they eat. Spirea is a favorite with them. Hundreds may be seen on a single bush, tumbling all over each other in their quest for food. Some of the free-flying females will find the nests of birds or rabbits, the fur of some dead animal, or the pellets of an owl. In the open, their life cycle is slowed down, so that the larvae may require two or three years to reach maturity. Apparently all except the Furniture Beetle are able to survive our coldest winters.

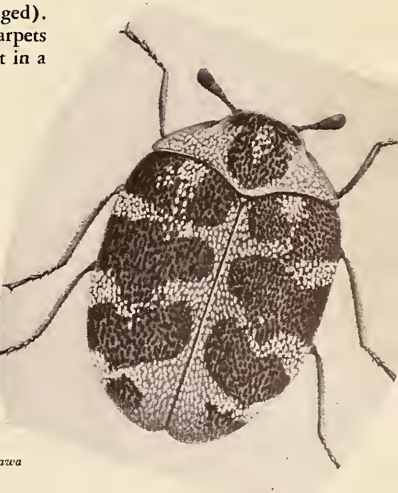
A very large percentage will find their way back into buildings and search out suitable materials upon which to lay their eggs. This is one reason why buildings or parts of buildings close to flowering shrubs are usually more heavily infested than others. If closed windows thwart their yearning for sunlight and food, they will get along fairly well indoors, proceeding with their family life. Fortunately, they are not particularly prolific. The offspring of a female may number from only 50 to 200, which is roughly comparable to the clothes moth but far below the productivity of most other insects.

The greatest wanderer among the carpet beetles is *Attagenus piceus*, commonly known as the Black Carpet Beetle. It began its wanderings in eastern Europe and Asia and has taken up its residence with man in almost every part of the world. It was undoubtedly an unknown companion of the earliest settlers in America and probably took its toll of their meager wardrobes, but it did not receive a name until a year after George Washington became president, in 1790.

Like the early American settlers, the Black Carpet Beetle found the country much to its liking, and it prospered. The relatives it left behind in Europe have apparently continued their humdrum and unexciting lives, because they are still of minor importance as household pests. But not so the immigrants. They have kept pace with the growth of the country, and today their offspring can boast that they cause more damage than any other household pest.

They are rather general feeders. You might find the larvae living in the sparrow's nest outside your window or feeding upon milady's choicest silks. They feed no more enjoyably upon a mink coat than upon one that is a mixture of wool and cotton. Feather pillows intrigue them and so do woolen socks. They will eat dried soups and powdered milk, and anything containing yeast will attract them. They relish dried insects and dried plants. They will only occasionally devour white cotton goods, especially if they contain starch. They'll eat almost anything of animal origin, but woolens are their favorite food.

Extensive and serious damage may result in various ways. In a large and exclusive apartment house on New York's Central Park, the residents of most of the apartments facing the Park complained of damage by the beetles. In some cases it was stated that the larvae crawled over the beds, and one tenant claimed that two or three could be found each day between the sheet and mattress of the bed in which she normally slept. After a few such experiences, she could no longer endure the thought that



➤ **THE BUFFALO CARPET BEETLE** (enlarged). Its larvae favor furs, woolens, and carpets and have been known to ruin a fur coat in a single season

▼ **THE LARVA** of the Buffalo Carpet Beetle (enlarged and natural size). Once it has found a good feeding place, it is apt to settle down there and reach out in all directions in search of food

Photos courtesy Dominion Dept. of Agriculture, Ottawa

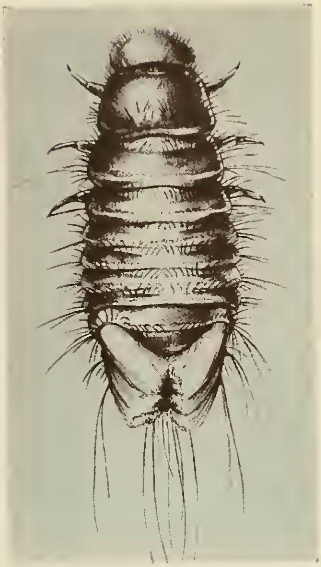


Photo courtesy Dominion Dept. of Agriculture, Ottawa

▲ **The larva** of the Varied Carpet Beetle is not too common or too destructive in the home, but its preference for dried insects makes it the chief pest in museums. (Photo much enlarged)

the ugly little worms might crawl over her, and, moreover, she was afraid they might carry some disease. The tenants were certain that the larvae and beetles were entering the apartments from the hallways. In this case, it was not so.

An examination of the infested apartments and hallways quickly clarified the situation. The heaviest infestations occurred between the fourth and ninth floors. In practically every apartment examined, dark closets and dark sections of the rooms showed a light to moderate infestation. In a few closets, larvae were fairly abundant in cracks in the floor and under packages and other stored materials. They had not gone far into the halls. They had entered the apartments through the windows as healthy adult beetles. The Park was their outdoor feeding ground. They had mated there, and the females returned to human habitations in order to find food for their offspring.

An entirely different situation occurred in an apartment in the borough of Queens. This was a much older building, and the hall carpeting had been in place for many years. Large stretches of it along the walls had been honeycombed by the feeding larvae. Since the larvae wander freely, it was only natural that they had found their way into apartments. It was not uncommon to observe a half dozen of them in a single hour slithering away beneath a closed door or heading for concealment under rugs. Many of them had found their way into closets to feed upon winter clothing and blankets.

Even a building or apartment that has been vacant for two or three years may house a huge population of this pest, if there is adequate food. Usually the buildings have been left in an infested condition. In the lint in floor and wall cracks and behind baseboards, there may be plenty of food to maintain a thriving host of larvae for many years. Their presence is easily detected in such a case by the scores of dead adults on window sills and upon the floor beneath, where they have died in an attempt to reach the outer world.

One of the most serious infestations that has come to my attention occurred in a factory building used for the manufacture of dried soups. The building had been vacant for a considerable time, and there was no indication that pests were present. But in late spring adult beetles began to appear in alarming numbers. I was unable to determine what had been processed there previously, but it was certainly something that appealed to the larvae. It did not take long to discover that the beetles were emerging from cracks in the floor. These were packed solidly with whatever the larvae were eating, and hundreds of holes had been chewed in the caked substance by the adults to enable them to reach the wide-open spaces. Control was complicated because there was a double wooden floor of rather rough construction.

The Black Carpet Beetle is well adapted to survival under adverse conditions. Under the most favorable conditions, with ideal temperature and an abundance of food, it may develop from egg to adult in about six months; but if the going is rough, the life cycle may require as much as three years. The normal period of development is one year.

It is the ability of the Black Carpet Beetle larva to endure hardships, together with its habit of wandering about and feeding whenever it is hungry, that makes it such a serious pest. Most carpet beetles, like clothes moths, feed within a limited area. But a single Black Carpet Beetle larva may eat in a score of places, chewing halfway through the cloth or chewing off patches of fur over a large area. The damage may pass unnoticed, but once the clothing is worn, the weakened strands quickly give way, leaving the owner to wonder why such a thing should happen.

Anthrenus scrophulariae is known in Europe as the Old Fashioned Carpet Beetle or the Common Carpet Beetle. In America it is the Buffalo Carpet Beetle or Buffalo Moth. Many Americans have the idea that it bears this name because it was first a pest in Buffalo, New York. Actually, the insect was described in Europe more than 100 years before it was found, as

▲ **These damaged spots** in a piece of untreated mohair are the work of Black Carpe Beetle larvae. In a controlled experiment, th larvae were placed in the mohair and in fou months had caused this damage an immigrant, in Massachusetts. Another, and more logical explanation for the name is that the larva is so chunky and well covered with fur that it might give the impression of a buffalo's head and shoulders. But even this explanation is evidently without foundation. Almost certainly the origin of the name is to be found in the memories of a rapidly dwindling number of Americans who lived in the days when (or shortly after) great herds of buffalo roamed the American plains. In those horse-and-buggy days, and even as late as the 1890's, almost every farmer, and untold numbers of town and city dwellers, owned a buffalo robe. It was looked upon as a necessity for winter driving. Our robe, which lasted, I am sure, until close to 1910, had two purposes. It served as a bedroom rug. In winter, we children would leap across the cold floor and land in its heavy fur, grateful for its warmth as we dressed hurriedly for breakfast--and school. At other times, when we hired a horse and cutter (sleigh), or went on hay rides, the buffalo robe went with us to keep us warm. I do not remember what happened to our robe, but it undoubtedly became old and decrepit. The "Buffalo Moths" probably helped a lot to render it useless, because such a skin provided an ideal breeding place.

Photos courtesy Collins and Aikman

⮝ **Larvae were planted** on this piece of treated mohair velvet, and at the end of a six-year test, no damage had resulted. Carpet beetles are hardier than clothes moths and more difficult to kill

Furs, woolens, and carpets are the favorite foods of the Buffalo Carpet Beetle, and when buffalo robes were stored for the summer they naturally became infested. Hidden in the deep, thick fur or in creases in the woolen backing of the skin, the larvae remained undisturbed during the warm part of the year, which is their growing season. I do not happen to have seen a badly infested buffalo robe, but I have seen other furs that were ruined by this pest in a single season.

The larvae prefer to work in the deep, dark fur, chewing off and eating the bases of the hairs. Once they have found a good place to feed, they are apt to settle down. At the base of fur hair, they build a little cell and reach out in all directions in search of food. They do not require too much in a single meal, and they may go for days without feeding, but by the time they have reached maturity, a quarter square inch of hair may have been chewed away at the base, and when the fur is worn or brushed, the loose hair is pulled out. In the days when coonskin coats were a mark of collegiate sophistication, I saw examples that were ruined in a single summer. One thing that helps to reduce the extent of damage by these beetles is their love for the skin itself, because the rich oils it contains sometimes cause them to feed upon the leather without eating clear through it, rather than upon the fur.

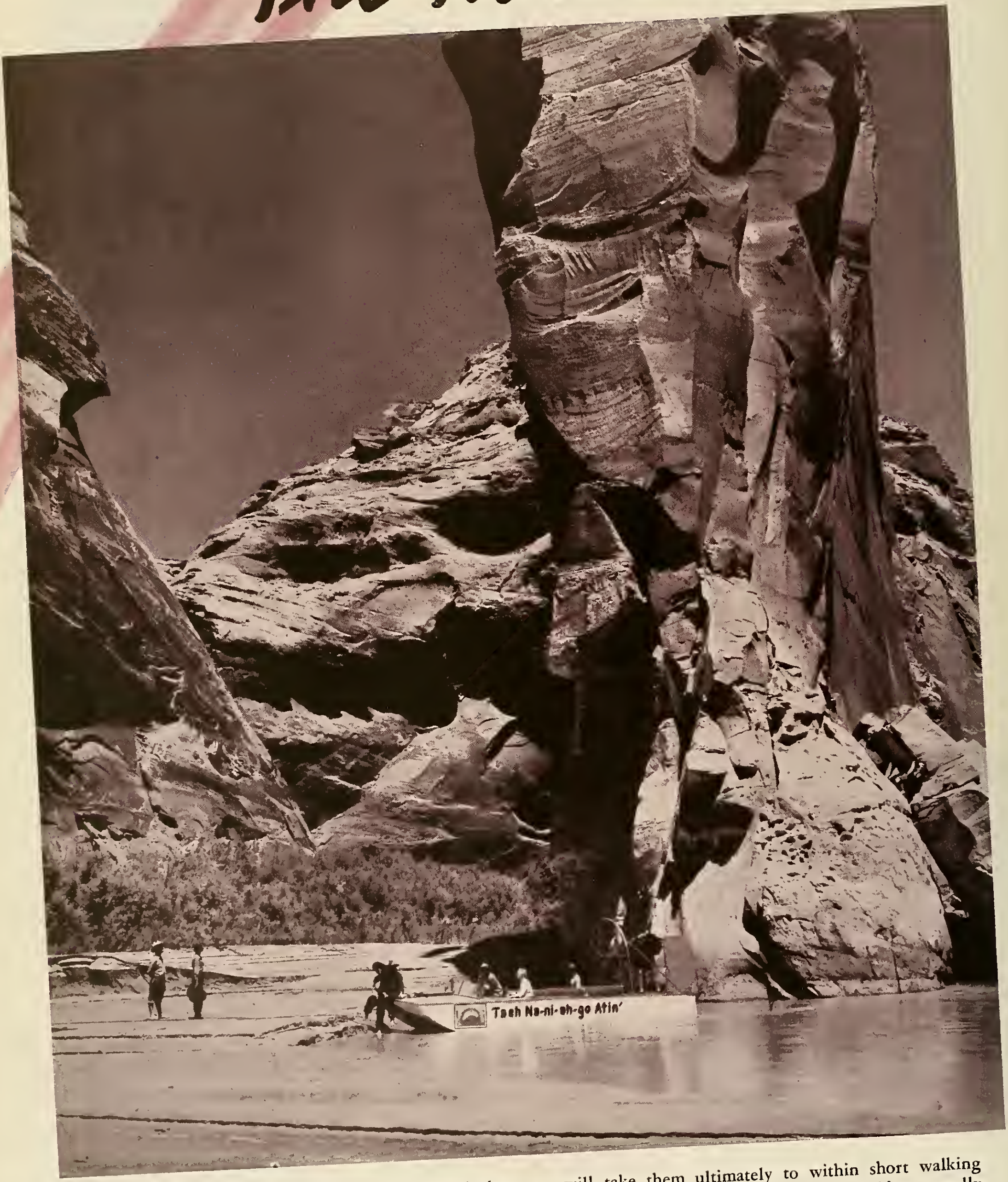
In deep and luscious woolen carpets, the damage done by this beetle may be concealed and not understood by the casual observer. Some years ago, I was called to the home of a former postmaster-general to determine the cause of damage to the living room carpet. It had been the custom to keep the shades drawn during the day, unless there were visitors. As a result, the room was in darkness, or at least very dimly lighted, for most of the 24 hours, and the Buffalo Carpet Beetle found things entirely to its liking. The broadloom carpet that stretched from wall to wall undoubtedly looked quite normal to almost everyone and was surely greatly admired by those whose feet trod upon it. But having seen such things before, it did not look beautiful to me. All around the edge of the carpet, two to five feet from the wall, were tiny mounds. Beneath each mound was the larva of a Buffalo Carpet Beetle that had chewed away the base of the warp. I explained the situation and to demonstrate pulled away the loose wool and disclosed the culprit. The party who had sought my advice (an interior decorator) was so intrigued by the "discovery" that she went about the room on hands and knees, plucking at every little elevation. She stopped only when I pointed out that if she kept it up, little of the carpet would be left.

In some parts of the country, the Buffalo Carpet Beetle is the chief pest; but it apparently does not get along too well with the Black Carpet Beetle. Where the latter occurs, the "Buffalo Moth" usually takes a back seat. In buildings heavily infested by the black variety, the "Buffalo Bug," as the larva is often called, occurs but sparingly. I suspect that the wandering habits and general feeding habits of the Black Carpet Beetle discourage not only the Buffalo Carpet Beetle but also other members of the genus *Anthrenus*. It is quite possible that the larvae of *Attagenus* will eat the eggs and young larvae of its relatives.

The Varied Carpet Beetle (*Anthrenus verbasci*) resembles the Buffalo Carpet Beetle in many respects but is much less brilliantly variegated, since it wholly lacks the reddish scales that form such conspicuous markings on the latter. It is not encountered too commonly in America, and extensive damage by it is rare. While it does like woolens, furs, feathers, and related things, it seems to prefer dried insects to all other articles of food, and it is the chief pest in museums. It shows good taste in its second preference, which is silk. The Mu-

Continued on page 282

The Rainbow Land



▲ Sentinel Rock. Passengers in the "airplane boat" pause to view this 300-foot column of rock that guards the entrance of Waweap Creek. The boat will take them ultimately to within short walking distance of the famous Rainbow Bridge, usually approached by an arduous overland route

Glen Canyon

Stories and scenes from a little-known section of our spectacular Southwest—a region now becoming accessible to the tourist who likes to venture from the beaten path

By Joyce Rockwood Muench

Photographs by Josef Muench

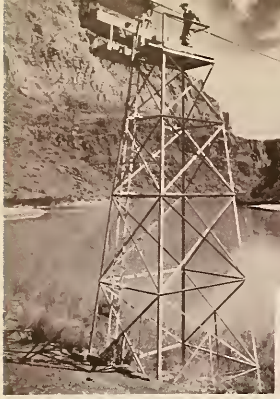
GLEN CANYON might be called the little-known parent of a famous child—the Grand Canyon. You may not have heard of it, since it has no Hoover Dam, no Grand Canyon National Park, and not a single bridge to publicize it. Glen Canyon may be almost peaceful in comparison with several of the more rambunctious offspring of this fabulous river system, but the name Glen scarcely does justice to some of the finest stone architecture in the world.

The Rainbow Land through which the Colorado River has cut its way in southern Utah and northern Arizona embraces 162 magnificent miles of winding art galleries. Burnished red sandstone cliffs hung with "tapestry," the flying buttresses of Rainbow Bridge, and the overpowering simplicity of Music Temple are within this domain. Here one also sees the staunch pillars of other stone bridges—Owachoma, Sipapu, and Augusta—the majesty of Navajo Mountain, and, of course, the sinuous, powerful Colorado, coursing silently through primeval land in the largest unsurveyed area in the United States!

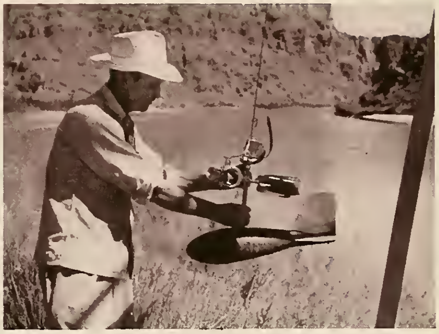
Native legend has it that long ago the Indian god Tav-woats made a pathway from the balmy western land, so that an old chieftain might visit his dead wife, Nu-ma. The Indian promised never to describe the country and to cease mourning for Nu-ma on his return. To make

▲ THE WORK of the mighty Colorado in carving these canyons can now be conveniently studied from water level. This strangest of all river boats is driven by an airplane propeller. Passengers study the colorful cliffs at close range and camp for the night where sunset finds them

➤ EVENING IN GLEN CANYON. The boat passengers have climbed up from the river's edge to watch the setting sun paint the walls of Glen Canyon with richer hues. Most of the area they view here has not been surveyed



< WATER-GAUGING CABLE TOWER at Lee's Ferry. By means of the cable car and the instrument suspended near the base of the tower in this photograph, the velocity of the Colorado River can be determined at any distance from shore. The resident engineer, Mr. Jim Klohr, is seen on the platform



> MR. KLOHR exhibits the delicate instrument whose revolving cups measure the velocity of the river. The 100-pound weight attached to the instrument enables velocities to be taken at various depths

< CAMPING ON THE COLORADO. A fire built on a sand bar along the shores of the Colorado River in Glen Canyon makes home for the night for a party going upstream from Lee's Ferry in northern Arizona. When the fire goes out, the voice of the river will lull the travelers to sleep in their sleeping bags

▲ MRS. ROLAND USHER of Cortez, Colorado, shows the rod with which she caught these fish

▼ FISHING FOR SUPPER. In a quiet cove, sweet-tasting catfish are easily caught for the evening meal. The boat has an Indian name meaning "Trail to Rainbow Bridge"

sure that others wouldn't make the journey, Tav-woats filled the rocky trail with a thundering stream. And that, say old Indians, is how the Colorado River and its nineteen yawning gorges came into being.

White men have shared the Indian's fear of the river, spinning their own weird tales. In earlier days, people used to say that the stream dived underground and plunged over tremendous walls as it raced through a region destined to remain forever unknown!

Lest you think too lightly of Tav-woats' injunction, consider that no man has yet been able to follow the Colorado upstream through its 1360 miles of twisting rapids, and not many have descended it.

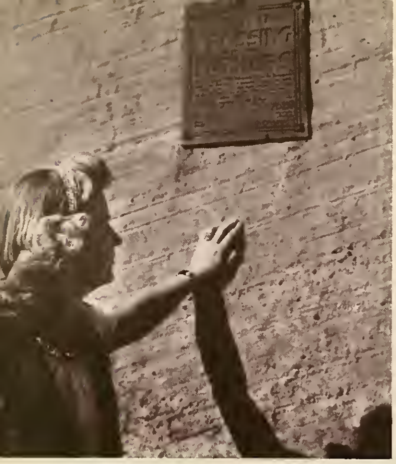
But it is high time that Glen Canyon made its debut and that it be accepted into the ranks of natural marvels. Don't expect it to offer you material wealth or hospitable lands for settlement, but be prepared to stand spellbound before its sheer grandeur.

Glen Canyon is less temperamental than most of its kin and maintains a gradual two-foot drop to the mile. The Paria River, which enters it from the Northwest, drops 7400 feet from source to mouth—an average of 43 feet to the mile. The Escalante drops 41 feet to the mile; the Last Chance, 70. Still more precipitous is Warm Creek with 90, Waweap with 100, and Rock Creek which tops them all at 285 feet downward for every mile ahead!

Rainfall is a scant nine inches in the highlands of the plateau and five inches in the lowlands, but it is delivered like a sword thrust, now here, now there, never generally. Extremes in climate, terrain, and formations are the norm. With such spasmodic rainfall, it is no wonder that the swift tributaries pour vast quantities of silt into the main river, which already has no small burden collected farther upstream. Some of this falls to the bottom to be stored until rising water can increase the

◄ An airplane view shows the rugged land through which the Colorado has cut its serpentine course. Navajo Mountain, 10,416 feet high, rises in the background

▼ For 135 miles in southern Utah and northern Arizona the Colorado River passes between the red sandstone walls of Glen Canyon. The absence of rapids enables the traveler to enjoy the spectacular rock sculpture without anxiety

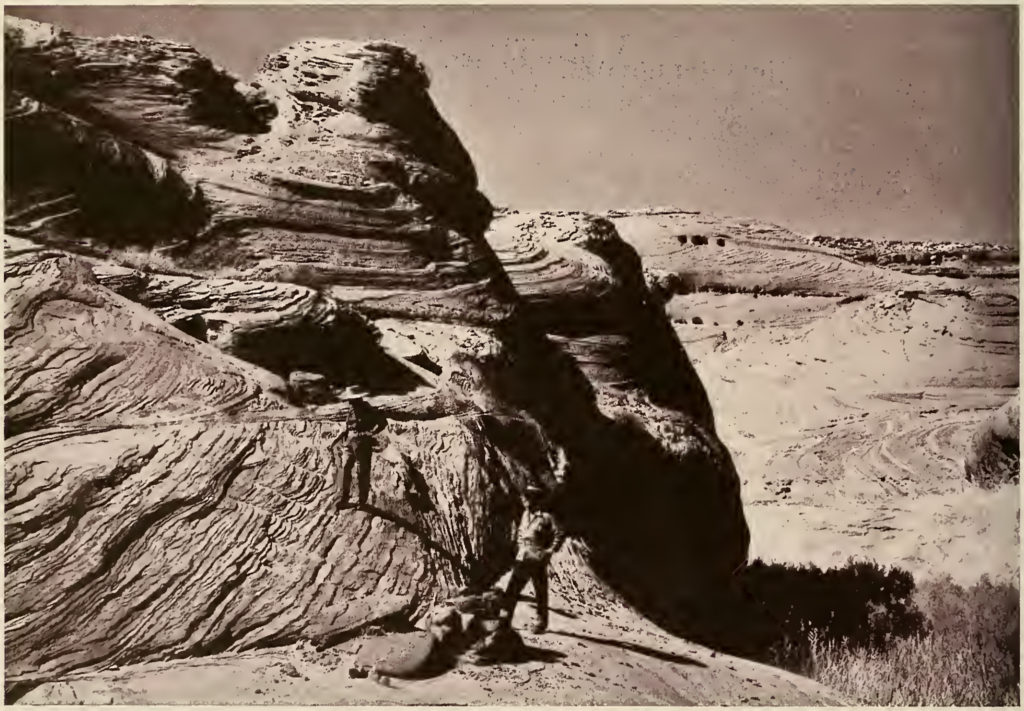


carrying capacity of the river. But it will take another uplift of the land to sharpen the Colorado's cutting tools.

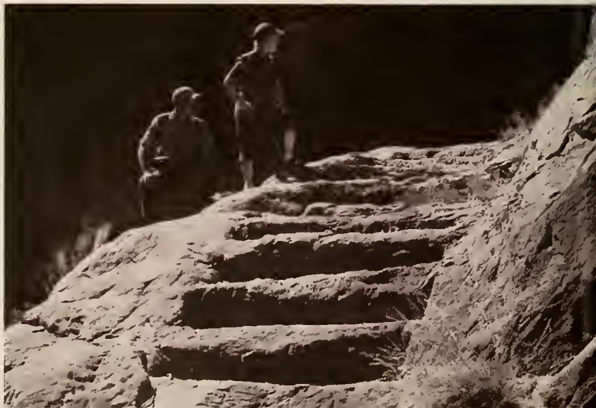
It is now possible to view the majestic rock-sculpturing of Glen Canyon from an excursion boat powered by an airplane motor. In this unusual boat, Art Greene will take you around a thousand snaky turns to reach the goal of all dreamers, Rainbow Bridge.

From the water level, the fine graining of Glen Canyon's sandstone and the elaborate cross-bedding can best be seen. But it is from a distance that the massiveness and raw color of the curving walls can best be appreciated. Here and there, it is as though a

➤ WHERE WHITE MEN first crossed the Colorado: a bronze plaque commemorating an important achievement in western exploration. Here, in 1776, a Spanish party struggled down a narrow gap to ford the river, which otherwise would have interrupted their 1600-mile journey through the wilderness



▲ HERE THE SPANISH EXPLORERS, including Father Escalante and Father Dominez, brought their horses down over the swirling sandstone to reach and cross the Colorado River in Glen Canyon. At the right, the rock drops off to a little creek leading down to the Colorado



➤ FARTHER UPSTREAM, pioneering history was again made at Hole-in-the-Rock. These "Mormon Steps" were cut in 1880 to enable 250 Mormon pioneers to descend a 1000-foot break in the cliff, along with 80 wagons, 200 horses, and 1000 head of cattle painter had splashed huge bands of colors to produce what are known as "tapestry walls" along these corridors of time. Nature protects them by layers of so-called "desert varnish." But every season of frost and snow prepares a layer of outworn scenics for the next downpour to wipe away, and in places great blocks of material have been neatly squared off, ready for removal to the lower reaches.

Here and there throughout the length of the Canyon, wind, water, and sand have shaped indentations from egg-cup size to gargantuan arches and embayments. Music Temple is the finest specimen of this artistry. About 500 feet in diameter and 200 feet high, its perfect acoustics carry a whisper across a clear pool and among the moss and ferns of this secret chamber, which is reached from the near-by river through a narrow gorge. Monuments stand guard like ticket takers wherever a stream comes into Glen Canyon and lead to other galleries and showrooms. Sentinel Rock at Waweap Creek is a great carved tower about 300 feet high, and Incinerary Urn at Warm Creek is a portentous and classical symbol on the Utah-Arizona border.

Some of the early explorers left their mark on this forbidding region. In 1776, a Spanish party struggled down the narrow gap to ford the river—one adventure in a 1600-mile jaunt through the wilderness. This spot, known as the Crossing of the Fathers, had been used by the Ute Indians for hundreds of years, and the Navajos continued thereafter to take advantage of it. A bronze plaque set into the sandstone commemorates the first crossing of the Colorado by white men, and faint scratches on slippery rock may have been made in that year to get Spanish forces safely down to the river's edge.

Pioneering history was also made farther upstream at Hole-in-the-Rock. In 1880, 200 men and women and 50 children descended a 1000-foot break in Glen's walls over a "road" constructed for the passage of 80 wagons, 200 horses, and 1000 cattle from Escalante to found the settlement of Bluff on the San Juan River. The feat was one that anyone, laboriously climbing up through that desolate "hole," will agree may never again be duplicated. A trace of the trail on loose slopes, some beautifully weathered steps, and a recent plaque of bronze are all that remain of what some consider the most formidable wagon trek in world history.

Lee's Ferry, too, is steeped in

▼ RISING SHEER FROM the water's edge, the sandstone walls of Glen Canyon soar skyward. The extreme edge of the Kaiparowitz Plateau is seen across the water, above walls embroidered with fantastic designs and arches in the making. Here, in Glen Canyon, is some of the world's finest stone architecture

early western tradition. A gauging station on the bank of the river now brings new activity to the tiny fort and ferrymen's cabin that slumber in the sun. Near by, in the widening valley of the capricious Paria River, John D. Lee's early farm still produces watermelons and asparagus. A row of tiny graves in a neglected cemetery tells of tragedy that struck at the ferryman's family one summer, miles from any doctors who might have diagnosed and treated diphtheria. From 1872 until 1929, when it was outmoded by Navajo Bridge and U. S. Highway 89 (only 7 desert road miles away), the ferry made trips across the water. Every river adventure has included this spot, and it is the division line for the Upper and Lower Colorado, the zero point for measuring up and down the stream. Travel up through Glen Canyon begins here.

At Mile Sixty-eight the dark slit of Aztec Canyon beckons the visitor toward the Rainbow Bridge. A trail ascends gradually between sheer walls to what is probably the most famous natural arch in the world. Since Dr. Byron Cumming's party found it in 1909 with the aid of a Piute guide, only about 5000 white men have seen the Rainbow. Now a National Monument, it is reached by trail from Rainbow Lodge in Arizona or down the San Juan's exciting course through Utah. With a third route now possible, up the Colorado itself, thousands more will come, finding its noble proportions a fitting climax to the architectural splendor of Glen Canyon.

Still farther up, Dandy Crossing (now known as Hite) boasts the only ferry in our wonderland. It was first used as a ford in 1880, and miners pursued their forlorn hopes from it and from Lee's Ferry. Oldtimers can rattle off the names of gravel bars where homemade rockers and sluice boxes were used in the search for gold—Grub Stake, Good Hope, Olympia, California, Moki, New Year, Burro, Boston, Klondike, and Shock. Good Hope, the only patented land, was strong enough to induce promoters to bring in a water wheel. A power dredge was operated at another in 1900 but did not produce enough to pay for its installation. The California, however, brought $10,000, and it is still possible to earn daily wages from recurrent streaks on the river.

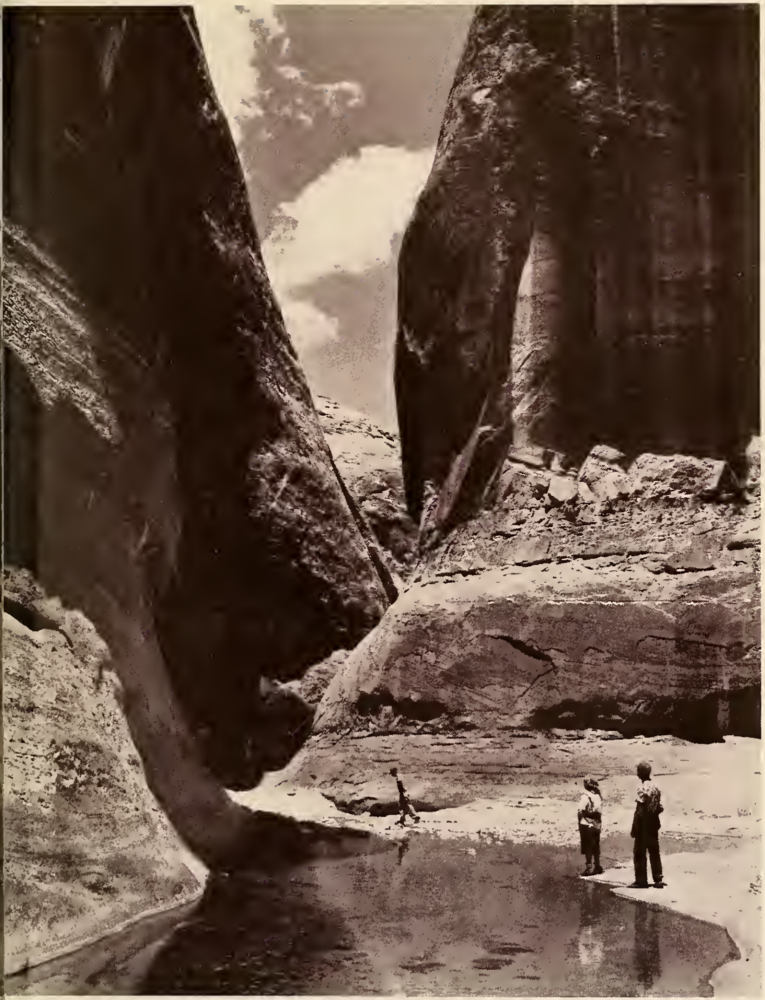
There was a renewal of mining activity in 1910 with steam dredges and power shovels freighted from Marysvale. A steamboat was set afloat to pull barges upriver to Warm Creek. Coal mined there and carried on horseback to be floated down the water was used to provide power for a gold mine on the Paria River. The first trip proved

▼ **ONE OF MANY REGIONS reached only by boat. The overhanging cliffs at right bear the strains of water, while the rocks at left have been shaped like loaves of homemade bread**

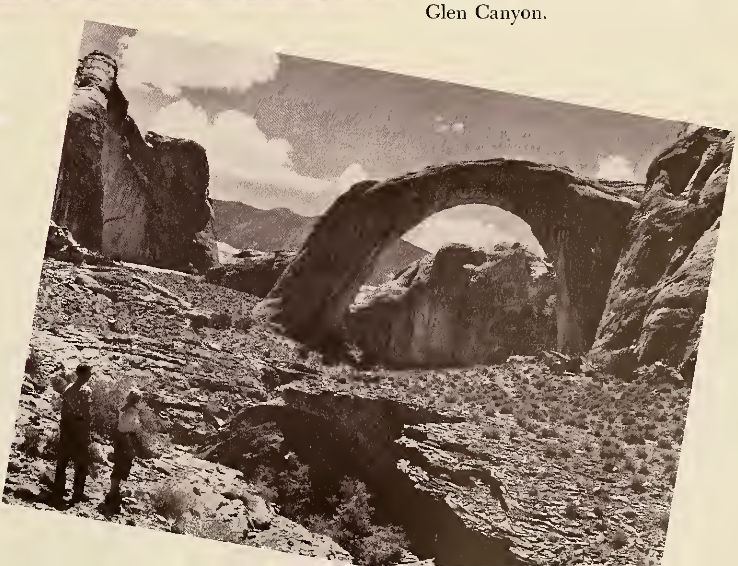
that the big boiler ate up all the coal that could be dug and could scarcely hold its own against the current. At Low Water, the rusting old boiler and hull peer disconsolately above the muddy waters.

Glen Canyon and the Colorado River have not treated kindly those who would search for wealth in the ground. But they have no objection to men clambering over the rocks, delving into a hundred canyons that cry out for exploration. Hidden here are arrowheads and pottery that have long lain buried; and the limestone, interlaced between layers of sandstone, provides lush gardens of ferns and saucy-faced monkey flowers. Sand bars, changing from season to season, allow willows and cottonwoods to make shade for noon siestas, and the river is always considerate in providing driftwood for cheery campfires. It offers the delicious meat of the catfish for a nominal amount of effort. Shadowy ravines write an invitation to explorers in their unknown glens and retreating plateaus. Navajo Mountain holds its own mystery for Indian and white man. No Navajo will accompany you to its top, past War God Springs, but scientists say it is a huge laccolith—a great bulge of volcanic rock that never erupted.

The river, self-appointed curator of this canyon museum, alone knows the complete listing of the exhibits in the Rainbow Land of Glen Canyon.



▲ Bridge canyon. This cleft, with its clear stream, is named for the great Rainbow Bridge, three miles farther up. In places, the sky is almost shut out by the multicolored cliffs



➤ Sweeping in a magnificent arc to a height of 309 feet above the bed of the creek, Rainbow Bridge enjoys worldwide renown as a natural wonder, even though only a few thousand people have ever seen it. Its span is 278 feet, and the rock is 42 feet thick at the top of the arch

The First Ascent of El Sangay

▲ THE ONLY INDIAN who had the courage to venture as far as the snow line on El Sangay: Manuel Olalla, a thoroughbred Quechua. He was a trained zoological collector and spoke Spanish fluently. Near by are the grass lean-tos, or *chozas*

Reminiscences of a momentous expedition of 1929, when the Flaming Terror of the Andes was conquered. The adventures of four men who forced one of the world's great volcanoes to reveal its secrets

(*Concluding Installment*)

By ROBERT THOMAS MOORE
Associate in Vertebrate Zoology, California Institute of Technology

All photographs by Moore Expedition

As I lay in my blankets listening for sounds that would indicate that our Indian porters were abandoning us, I mused on the bulky animal that had brought a touch of Africa to the Andes. It was not the common tapir of the tropics but the rare Mountain Tapir—a shaggy, black-haired, mahogany-cheeked beast, supposed to be extinct or nearly so. But strange as it may seem, it was a tiny hummingbird that captured my imagination. Once more the Fire-throat, Herran's Thornbill, had called upon us! Like a visitant from some other world, it had volplaned out of the ether and dropped on the golden clusters of our "pear tree," the only touch of color on our wind-blown eyrie. For one dazzling moment it hovered before us—took one sip of chilled nectar—and was gone!

Morning brought drenching rain. The Labyrinth was choked with clouds. But to our surprise the peons were still with us. Their leader had recovered and, miracle of miracles, was willing to proceed! We hastened to take advantage of the changed attitude, but they insisted on taking the hardest route—the Labyrinth! This had only one compensation: we could survey the bird life of the canyons and possibly find the nests of both Fire-throats, *herrani* and *stanleyi*. While we consulted, however, disaster threatened in another form. The best of our two remaining Quechuas was found in the choza, incapacitated by swollen feet. We left him to recover and follow later.

Soon we were slipping and plunging down the worst slope I have ever tried to negotiate. The rains had turned the ash into a jelly-like paste. There was no trail. With heavy loads, neither peons nor ourselves could proceed until steps were laboriously gouged into a zigzag trail. Hours followed which left a dreary memory—a kaleidoscopic vision of icy streams, raging torrents, moss-covered blocks of lava that proffered treacherous footholds, steep slopes and cliffs that were always facing us on the opposite side of streams. Dripping clumps of paja grass lacerated our hands with their saw-edges, and on the endless paramos above this sponge-like world, gnarled trees blocked our progress along knife-edges. Attempts to crawl through interstices were made with sure knowledge that one slip would mean a plunge into the gorge. And always and always there was stream after stream, torrent after torrent, and fords so numerous that definite memory of them is lost. Until—at length we reached the Rio del Volcán!

Here the peons balked. They were tired out. One poor fellow, more heavily laden than the rest, had tottered along until he had to be helped at every crossing. His leader cried out, "*No se puede ir adelante!*" He claimed we were trying to drown them and that they would "die of the cold!"

Persuasion and threats failing, we gave them the one food they wanted—our remaining bread! An added demonstration by Terry, who dashed through the swollen river and then 1000 feet up the opposite cliff, shamed them into moving on. An hour later the fords became more shallow and the water dropped to the knees. We waded for hours in a dark canyon, climbed the sheer cliff of a waterfall, followed an ash plateau beside a cinder canyon, and reached an apparent cul-de-sac, blocked by transverse ridges and deep gorges. That camp for the night we called "Sangay."

By evening the Shroud lifted once more for a moment. There, directly above our heads, gleamed the snow-white cone of El Sangay, tremulous in the failing light. It was actually near! And one of the transverse ridges turned obligingly to the southeast, heading straight for the summit. We were on the northwest slope of the volcano. Obviously the end of the Labyrinth had been reached.

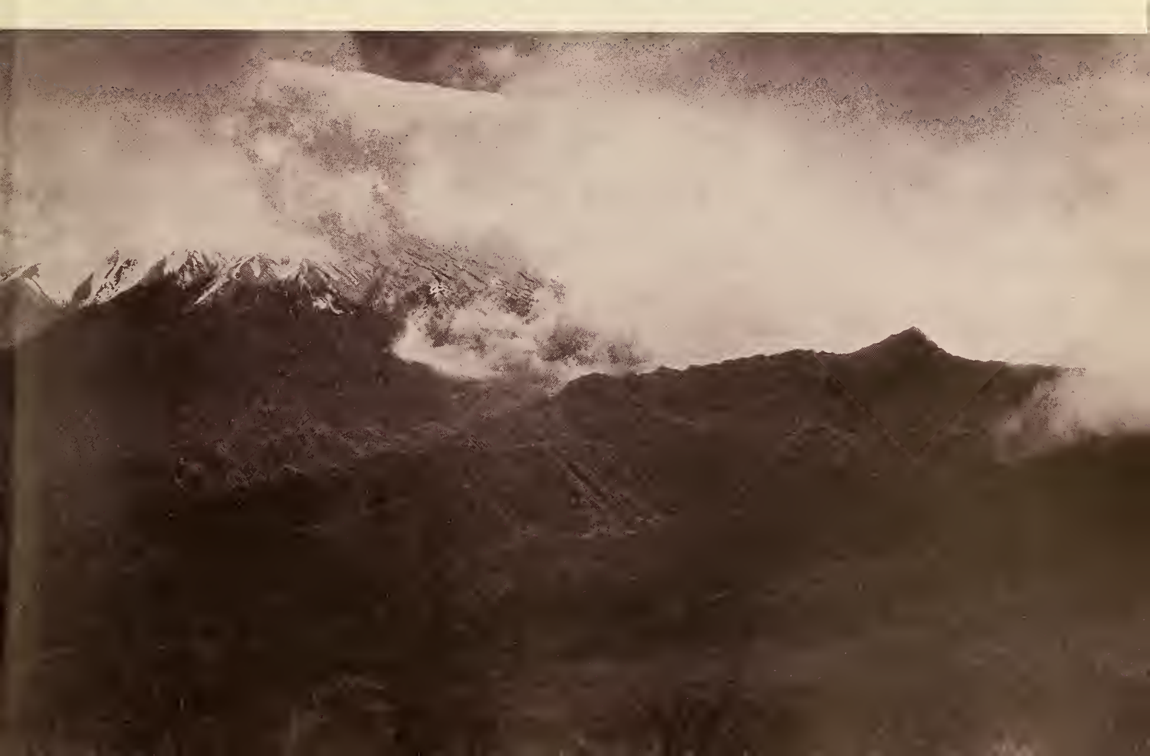
We now faced the base of a cinder bluff. A hundred yards to the left was the upper end of a huge canyon of great depth, probably 3000 feet. To the right, a small arroyo carried a minor stream. Over our heads hung enormous hummocks of sullen black ash. It seemed that only a slight additional shaking from the daily rumblings of the volcano would precipitate a landslide. A mile higher, the snow began, but we did not find any evidence of the glaciers mentioned by Dyott until we reached the crevassed area on the southern slope of the cone itself.

Again the peons refused to make an adequate choza, and we knew desertion was impending. Mutterings were overhead about "El Nieve!" and "El Volcán!"—up which they feared we intended to force them. Food supplies were dangerously short. Unless the rest of the deer meat could be brought from Carniceria, we would have to reduce our diet to tea. It was decided that Waddell and I would hunt for deer on the morrow while Terry and Lewis would take the ice tent (the "fiala") and pitch it on the snow. We forestalled desertion by sending the well peons back to Carniceria, securing their promise to help Teodomiro bring back the rest of the deer and tapir. They started at sunrise, leaving behind the exhausted peon, who had nearly lost his life the previous afternoon falling from a shelf of the gorge.

The deer hunt failed, but at nightfall Terry and Lewis returned. Success had crowned their effort. The tent had been placed on the last tongue of warm ash that crept far up into the snow field at an elevation of 16,000 feet. At last we had something tangible to fight, something besides water, morass, and clouds. On the morrow we might climb out of the Labyrinth and reach clear sunlight—and ice.

On August 2, Terry, Lewis, and I, with Manuel, the last of the faithful Quechuas, took to the ridge that served as a rib of the black network supporting the white dome above us. As usual it rained, and the cone was hidden by cloud. A black knife-edge wound its way upward, disappearing in the Shroud. Rapidly it narrowed and became bare of any vestige of shrub or grass. From five feet it compressed to four, then to three, then two and one! At length, a bare six inches supported us from the chasms that yawned on either side. We seemed like tightrope walkers suspended on a slack wire in a gloomy atmosphere over depths that disappeared into unknown space. Rain slashed on our ponchos and made the ash like slimy clay. Manuel, with his heavy pack, slipped down on all fours and crept. We took turns cutting steps for our feet. At times the ash crumbled and slithered away. Landslides had serrated the edge in places and compelled dainty stepping, as if we were walking over the bodies of sleeping

▼ ONLY RARELY did the forbidding peak disrobe for the climbers who sought to conquer it. From this point they crossed a number of gorges and ridges which took them out of the picture to the left. They ultimately ascended the knife-edge at extreme left, up to the snow line



enemies. For four hours we crawled like snakes up the skeleton buttresses of the volcano and reached a snow field at 3:30 in the afternoon. And then—we entered the region of Sun!

For two and a half weeks we had lived under the Shroud, veritable frogs with water below us and above. Now we had reached its upper edge and were faced by an intolerable fire that burned into our eye sockets. The glare of sun on snow was terrific. None too soon we donned metal eye-slits and surveyed the amazing new world we had entered. Below us stretched a sea of clouds clear to the horizon—north, west, and south. Its glittering snow-white billows formed the roof of the Shroud and concealed the dismal abysses below. To the east the tongue of ash on which our tent was standing ceased, and a gleaming snow field carried the eye up to the top of a perfect snow cone, outlined in startling relief against a sky of deep ultramarine. The slope seemed invitingly easy, but the morrow proved it an illusion. The appearance of a gentle slope was caused by a flat foreground, lacking shadows, that merged unseen into a steep ascent.

As we gazed, cloud wisps shot up out of the Amazon basin and, enlarging to great cumulus masses, catapulted upward at terrific speed, blotting out the summit. At the same time, the air column lifted the curtains of the Shroud behind us and for a moment revealed the entire route over which we had come during the past two weeks. The knife-edges, the Labyrinth, the Rio Volcán, Carniceria, and finally the whole valley of Culebrillas, its snakelike river, and even the white tent where we had said farewell to Carlos eleven days before, were visible through powerful glasses.

As we watched in astonishment, the dropping temperature warned us to prepare for a cold night. I sent Lewis and Manuel back to Camp Sangay with instructions to bring up the needed equipment. They took the ice ax to negotiate the "Knife-edge." We lit the optimus heater, thawed our frozen imaginations, and cooked a wonderful dinner of our last rice and raisins, using water from melted snow. Crawling into sleeping bags, we expected a cold night, but the ash beneath was warm and would have induced sleep had it not been for other causes. Confident the frozen-in ropes would hold, we were just falling into a doze when a terrific blast shook the tent. With it came the sharp impact of ice pellets against the frozen canvas. Neither of us spoke, but both were keenly aware of impending danger. Plainly the vertical air currents that had skyrocketed from the Amazon were tearing the Shroud to shreds and turning it into a hurricane of snow and hail. The Demon of wind pounded our tent with titanic force. The four-foot tent pole bent into an alarming bow. When the bow released, the tent canvas snapped taut with a report like gunfire. The ropes whipped the ice. Powerful gusts of the storm rolled under the ice cloth and lifted us bodily into the air, dropping us with a thud.

With only two in the tent, visions came of being rolled—tent, contents, and all—over the ridge to the west and down the half mile of ice. We bulked our weight strategically on the windward side behind the cut Terris had made in the ice wall. For four hours the wind buffeted and thumped us, and then came a marvelous calm. This lasted only a half hour, when once more the pounding renewed its onslaughts. Two more hours saw it slacken and allowed a few minutes' sleep before sunrise, when we rose for the contest with the frozen volcano. As I crawled through the low hole, a bleak scene greeted tired eyes. The ash tongue was drifted, and the tent walls were stiff with the impacted debris of the blizzard.

The morning light revealed that the heart of the volcano was not frozen by any means! At a distance, the conclusion had been drawn that no "smoke" was being discharged from the crater and that the so-called "most frightful volcano in the world" was extinct. Now, at close range, it was clear that gas clouds were being emitted, but the gases were unusually colorless. In comparison with the dense masses of gray emitted by Vesuvius, El Sangay's fumes are transparent. And yet they were pouring forth in great quantities. The giant was merely asleep and breathing heavily. The cone was perfect, greatly in contrast with the truncated top drawn by Whymper 50 years before, indicating that it had been quietly building for some time and that the orifice was choked with ash. These conditions are deemed an augury of early activity. It did not give us concern, since an eruption is generally preceded by seismic disturbances of a violent nature, and up to this time we had experienced only one violent earthquake, although there had been many minor "shakings."

These were the things we discussed in the predawn light, while Terry busied himself with breakfast and I endeavored to photograph the still swirling clouds. Although the wind had moderated, it bent the stiff tripod legs like willow wands and pierced bare hands to the bone. A sudden gust tore away the parka I was using as a focusing cloth and hurled it down the western ice slope. The night's snow was picked up by the gusts and stung face and hands like a whiplash. Absorbed in the difficulties of my work, I did not at first notice an increase in the whistling sounds about me, until I was startled by the passing of a large object near my head. Glancing downward I could see it bounding on the ice. It was a ROCK! Twice as large as my fist! Above me others were ricocheting on the uneven slopes. Clearly they were coming from the summit. Was it an eruption? I instantly dismissed the thought when I noticed they were not incandescent. Later we saw many of them lying quietly on the icy slopes near the crater. The powerful winds had disturbed them and set them in motion. If they had been projected from the crater for some time and frozen in the surface, it proved how powerful the wind had been tc wrench them from their resting places.

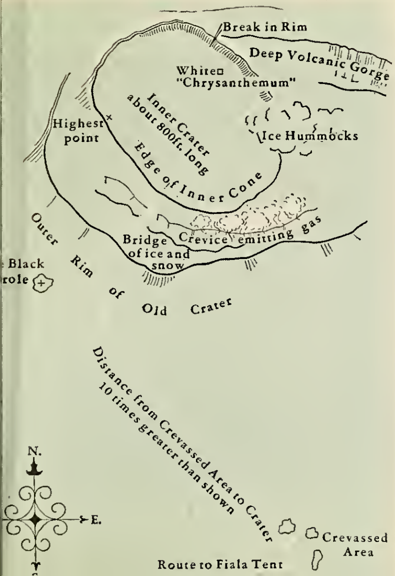
Dropping the tent to save it from wind and rocks and using the tent pole as an ice ax, we started for the summit. Our Paulin barometer indicated we were now at an altitude

< **At the lower edge** of the snow-cap of El Sangay. As the men lay on the canvas floor of the tent, a tempest raised them bodily and threatened to hurl them, tent and all, into the abyss

∨ **A gorge unexplored** until the Moore Expedition penetrated it: the ravine of the Rio del Volcán. It made a welcome route to the very base of El Sangay. And in it was discovered a bird new to science—the beautiful Golden Tanager, *Tephrophilus wetmorei*

of approximately 16,000 feet. Assuming the triangulation of the mountain to be correct, we had about 1800 feet of altitude to negotiate. Later we discovered that an inner cone had built up almost to 18,000 feet in elevation.

A few steps convinced us we were on the steepest side of the cone—the western. A direct ascent would be impossible without the ice ax, which Lewis had taken the night before for his return over the knife-edges. The frozen slopes rendered our snowshoes valueless. We had brought them and reduced the ice axes to one because Whymper's historic ascents of Andean mountains had indicated that most of them were covered with deep snow. This proved to be true of Mt. Chimborazo later, but above the 16,500-foot level, El Sangay was glare ice. If we were to make the ascent this day without ice axes, we would have to head for the southern slope, whose silhouette against the sky indicated an easier gradient.


Break in Rim
Deep Volcanic Gorge
White "Chrysanthemum"
Inner Crater about 800ft. long
Highest point
Ice Hummocks
Edge of Inner Cone
Outer Rim of Old Crater
Bridge of ice and snow
Crevice emitting gas
Black
role
Distance from Crevassed Area to Crater 10 times greater than shown
N.
E.
Crevassed Area
Route to Fiala Tent

It was on this southern slope that Dyott had plunged into deep snow and crevasses, but its easy grade was too inviting to be resisted. Furthermore, we would avoid the dangerous fumarole directly above us. We headed obliquely upward shortly after dawn. Soon the surface became so slippery that steps had to be gouged with the metal end of the tent pole. The force of the blows broke the pole. The slope became steeper. Terry slipped twice and barely prevented a long glissade. Another sharp blow with the pole sent the unbroken half flying down the ice field; it dropped out of sight a quarter of a mile below. In a vain effort to catch it, Terry took a long slide but succeeded in stopping himself on a flat area that saved him from disaster. We returned to the fiala tent, defeated. A cold lunch followed. It was impossible to cook outside the tent because of the wind, and the tent could not be raised without the pole. A sparkling afternoon tempted us to try again.

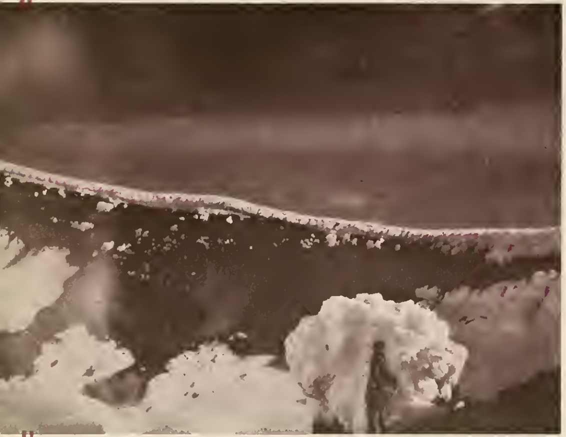
Considerable time had been spent in a successful attempt by Terry to recover pole and parka in the cinder field below. His energy was astounding! Every step was costly, a severe strain on heart and lungs in this rare atmosphere three miles above the sea.

Once more we pointed upward. The old steps made progress faster. The surface had melted slightly under the direct rays of the tropical sun. By 3:30 we had passed our old mark and reached an area of curious hummocks and mammoth formations. Some of these forms were 50 feet in height and conjured thoughts of titans of the last Ice Age. Obviously they indicated the beginning of a crevassed area—probably the sector that had defeated Commander Dyott in his courageous effort, after all his companions had been stopped by fear or mountain sickness. As Terry changed films to photograph the area, a sudden gust tore the film adapter out of his hands and sent it sliding down the mountain. It might have stopped on the softened surface had not some queer trick of fate turned it on edge and whirled it at a fast rate. The summit did not seem more than 1000 feet above us, but without camera as witness, an ascent seemed of doubtful value. Reluctantly we postponed further effort until the morrow.

Waddell and Lewis, without Manuel, reached the tent at 5:30 P.M. They brought good news. Teodomiro and the peons had reached Camp Sangay with deer meat. We could devote one more day to the ascent with fair regard for the safety of the party. Unless we should be impeded by swollen rivers, it would be possible to get back to Culebrillas by husbanding our rations. We spliced the broken tent pole with the ice ax that Lewis had brought and once more enjoyed a cooked dinner of hot venison and fried potatoes. The crowding of four persons, four sleeping bags, cameras, and other equipment into a six-by-six tent caused much amusement and took one and a half hours.

At 5:30 the next morning we were up. We plastered our faces with a thick coating of cold cream and cinema paint. Three inches of snow had fallen during the night and completely obliterated our tracks of the

▲ ABOVE THE sea of clouds that hangs almost incessantly over the lower slopes of El Sangay. Beneath it, the Indians say it rains every day in the year



▲ THE "CHRYSANTHEMUM": a pompon of ice. It was supported by a stalk of ice more than 50 feet in height, the base of which was concealed by the billowing vapors of gas within the crater

▼ TITANS FORMED of ice dotted the glaring landscape up which the climbers struggled. It was probably in this area that Commander G. M. Dyott fell into a crevasse and nearly lost his life on his unsuccessful attempt to reach the summit

▲ ON THE HIGHEST POINT OF EL SANGAY. Dr. Robert Thomas Moore is in the center, his son Dr. Terris Moore, now President of the University of Alaska, is on the right, and Waddell Austin of the University of California is on the left. Dr. Lewis Thorne is taking the photograph. None of the Indians would climb to the top to face the God of El Sangay, whom they feared

previous day. As the surface was frozen beneath, the snow made the going treacherous and compelled us to cut steps with the ice ax, retarding progress. Five hundred feet below the "hummocks," Waddell was struck down with "siroche," the curious mountain sickness that had incapacitated the great explorer Humboldt on Pichincha 127 years before. He lay flat on his stomach, attacked by violent nausea and headache. In accordance with previous agreement, the rest continued, but a half mile from the crevasses I ordered a pause and luncheon of hard chocolate, in order to watch the prostrate form below and determine if assistance would be needed. To our utter astonishment he picked himself up and stumbled toward us. Several times he fell prone on the ice only to rise again. At length he reached the party, and after a long rest and a bite of bread he continued courageously on. Throughout this hour, we had clung to a steep icy slope, with backs to the ice and heels in precarious toe holds.

From the hummocks we veered back toward the north, to avoid the crevasses on the south side of the peak, and took the steep western pitch, even though it obviously would require ice-cutting to the top. The use of the ax proved an increasing effort for persons loaded with cameras, tripods, alpine rope, barometer, and minor equipment. Turns were taken, but progress was slow. After several hours the slope eased up, and at the end of another half hour a soft area was reached where cutting could be abandoned. The large black fumarole, observed from Culebrillas, loomed to our left. We narrowed our zigzags to avoid it and headed directly for an icy ridge above us, from which clouds of white fumes were pouring. Ropes were now in use; they were tightened for the last effort. I took the lead, heading straight for the summit. At 1:15 P.M. we reached the apparent top, to discover we had surmounted the outer crater only. An inner cone from which masses of gas were pouring, rose still higher by several hundred feet. At our feet, between us and the base of the cone, yawned a gas-emitting crevice, which, as it curved to the south and east, widened to the proportions of a gorge. Outrushes of gas obscured the abyss, and its walls were fantastically draped with icy stalactites.

To our left the gorge narrowed. Over this a bridge of ice and snow offered a possible approach to the inner cone. I started across and broke through. The fall stopped suddenly with a thud. My feet were on hot ash below, which had melted the ice on its underside, and my neck was encircled by the surface ice. Scrambling out, I started up the ascent on the opposite side of the crevice. Breaking through the icy crust every few feet, we reached the edge of the inner cone and gazed down into the murky depths of the real crater, which never before had been viewed by the eyes of man!

The rest of the ascent around the frozen rim to the highest point of the southwest rim—the actual summit of the volcano—was easy. Standing there, we photographed each other. We did not know until later that we were really on a shelf of ice, extending out into, and actually overhanging, the abyss of the crater below! It was 1:50 P.M. of August 4th, 1929. Twenty-one days had elapsed since we had started on the trip, and during this time rain or snow had fallen every day, and most of the time every hour of the day! No wonder Lewis seized his harmonica and played a tune of triumph to the defeated God of the Crater. No one but our four Americans reached the summit. The Indians feared to face the "frightful God of El Sangay."

But there was much still to be accomplished if the appearance of the historic crater was to be recorded. Four cameras had reached the summit—an ordinary film kodak, a compur, a motion picture outfit, and a 5 x 7 for recording natural colors. The next three hours were employed in securing photographs of the fascinating phenomena about us. An ultramarine sky arched above us and reached the tone of indigo at the zenith. Slightly below our own level, the tumultuous ceiling of the clouds stretched for endless leagues. They were white when the gases from the crater blew to one side but tinged with gray when they interfered. The snow at our feet on the crater rim was tinted by the fumes, and it impinged on the tongue a nauseous taste like ammonium chloride. Great clouds of the gas interfered with the photographs and at such times took on a dark shade because of their density.

The main axis of the crater ran northwest and southeast. We were standing on the southwest rim, which actually overhung the sheer walls as they dropped into the smoking gulf. The crater must once have been much greater in diameter, perhaps a half mile; but in recent years a new cone had built itself several hundred feet higher into the air, and

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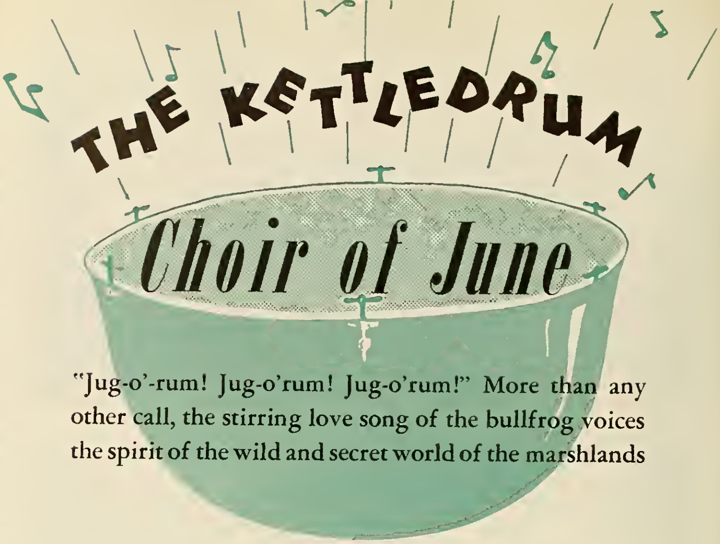
THE KETTLEDRUM Choir of June



"Jug-o'-rum! Jug-o'rum! Jug-o'rum!" More than any other call, the stirring love song of the bullfrog voices the spirit of the wild and secret world of the marshlands

By Ben East

Photographs by the author

IT lasts for about five seconds, rumbling and thundering around the reedy margin of the lake. Then the June night is still, save for the soft wind in the maples and elms, for 20 to 40 seconds. After that the Old One speaks once more and the others join in, and it starts all over again.

It's a deep and vibrant song, like a dozen bass fiddles crying "Jug-o'-rum! Jug-o'-rum! Jug-o'-rum!" over and over again. It's the incarnate voice of the warm nights of early summer, wherever there are marshlands. It's the kettledrum chorus of June, the mating song of the biggest frog in North America, the throaty bellowing by which the bullfrog courts the lady of his choice.

Some frogs croak; the tree frog and the common toad trill loudly and clearly; the tiny spring peeper plays sweetly his Pipes of Pan. But the bullfrog, giant of the tribe, has vocal equipment to match his bulk and his solid, squat appearance. He bellows a resonant, thrumming roar that can be heard a mile or more across fields and water on a still night. It has earned him his name of bullfrog. It is the loudest low-pitched sound to come from the throat of any cold-blooded animal in the United States north of the range of the alligator—and to those who know intimately the lakes and ponds and rivers, and the green jungles that border them, it is one of the most stirring and interesting of the many noises of summer nights.

The time for it to begin, in the lakes and marshes of the northern United States, is in late May or early June. Wild roses are in bloom at the roadsides, white water lilies are opening their immaculate, gold-hearted stars along the pond margins. There comes a warm still evening, and after sunset, when the late-spring dusk is settling over the land, the first bullfrog song of the year rolls up from lake or pond—a thundering kettledrum solo, or maybe a duet, that pulses and throbs and seems to shake the ground itself.

Those who live in the marsh country know then that summer is at hand. That is the unfailing harbinger, the sure forerunner, heralding summer as the first bluebird song and the first liquid notes of the red-winged blackbirds in March foretell spring. In a few more days the clover fields will be fragrant with bloom, the wild strawberries will ripen, the wheat will begin to turn bronze.

As a boy, I lived in a region of ponds and marshes and small lakes,

◄ Master musician of the marshes: the bullfrog, herald of summer in southern Michigan. Bullfrogs abounded there, and their singing was as much a part of the nights of early summer as the flight of the fireflies over those same marshes. Countless nights I lay awake in my room under the eaves of the old farmhouse, dreaming the long dreams of boyhood, shunning sleep deliberately that I might enjoy as late as possible the Jug-o'-rum song booming over and over again through the warm darkness.

No sound of the outdoors meant more to me than that throbbing, thrumming music from the lake margins. It spoke of lily beds, of coves where pickerelweed made a blue fringe in the shoals and big bass lurked in their underwater lairs. It hinted at secret bogland nooks where pitcher plants lifted their strange and treacherous urns of death, where showy lady-slippers hid their wine-stained white chalices in the green marsh tangles.

Not many in our neighborhood knew where the pitcher plants and lady-slippers grew, but I knew. They grew in the remote, untraveled thickets of the marsh, and the big frogs were part and parcel of that wild and alien and alluring world. They shared it with bitterns and nesting rails, thick-bodied water snakes and log-sunning turtles.

It was a world that lay literally at my dooryard, yet it was far removed from our upland fields, from the farmlands where we lived. Few penetrated it, few ever came to know its creatures and learn its mysteries, or so at least it seemed to me as a boy. It was a world that drew and held me by its wildness and aloofness, its secret places and its sounds and smells, its sinister wetness and the things it spawned. And to me the bullfrogs were its first spokesmen, its foremost singers, its great troubadours, relating its story, interpreting the spirit of the marsh itself as none of its other creatures did.

For me they still play that role. I moved back a few years ago to that same neighborhood. I live now on the farm where I grew up. And I await the kettledrum choir each summer as eagerly as ever and enjoy it as hugely.

Unlike many frogs, the bullfrog does not sing in unison in a true chorus. Or so, at least, the herpetologists contend. On the other hand, he rarely enjoys the chance to sing alone.

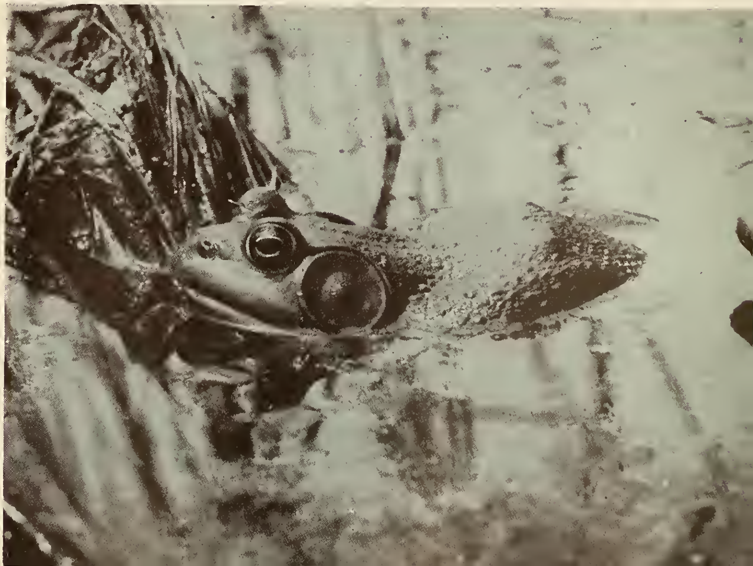
The bullfrog population of a pond, small lake, or section of marsh may consist of from half a dozen to two score or more of the big batrachians. And as often as one starts to sing the others join in, adding their voices to the clamor as if the first concern of each were to outdo all the rest. As a matter of fact, it is highly probable that this is exactly the case. Evidence and reason alike indicate that true rivalry inspires the performance. After all, the song is a courtship ritual, and through a long evening or an entire night the big frogs continue to thunder at irregular but very frequent intervals. Each time the first member of the choir bellows, the others simply cannot keep silent.

I have timed the thrumming chorus many evenings, on the medium-sized lake that lies at my door. They average about two performances per minute, each period of song lasting from four to seven seconds. But the rhythm of the singing is not entirely regular. Even at the peak of the mating season the periods of silence may endure for as long as 50 seconds or may be no longer than 20.

Always it seems to be the same frog that touches off the whole kettledrum orchestra. Whether he is the acknowledged leader and the others await his signal to begin, or whether the entire choir runs out of breath and regains it at precisely the same time and in the same order, I cannot say. The former explanation seems the more logical, however. At least I have observed, whenever I have timed the frogs (and, for that matter, through all the years I have listened to their singing) that almost unfailingly there is one voice that trips the symphony and that the others of the neighborhood follow time after time in the same sequence.

Frog A, on a reedy point at the east end of the lake, may open the number. Frog B, over in the lily cove a quarter mile away, sends his voice thundering forth a split second later. Frog C, down by the inlet, trails immediately, and then the entire group is bellowing in pulsing, broken cadence. Silence falls, and half a minute later they begin all over again, in exactly the same order.

Often there is one dissenter that



➤ ONE FROG touches off the orchestra, and the other kettledrums chime in insists on keeping out of step, singing his complete song time after time midway of the periods of silence, when no rival is articulate and when he has lake and marsh and all the night completely to himself. It seems there are rugged individualists even in the amphibian world.

In between the periods of deep-toned singing, in the green rushes along the shore, lesser characters will say "Grunk!" over and over again, in voices not without music. They are green frogs, closely related but smaller kinsmen of the true kettledrummers.

Almost unfailingly it is possible to distinguish the voices of individual frogs, especially those of outstanding size. One spring we listened night after night to one that far outbellowed all the others. From the timbre of his song, from both its pitch and volume, we felt sure he must be a frog of gigantic size, a veteran that had survived abnormally long the multiple hazards that beset the lives of all frogs, even the biggest of the clan.

➤ SOMETIMES HIS worst enemy is the man who wants frogs' legs for suppe

▼ IN HIS DOUBLE WORLD of air and water, the bullfrog faces danger from both above and below

◀ YOU MAY NOT see him near by but his music resounds far and wide

We named him the Old One and came to listen for his thunderous, earth-shaking notes to open the night's performance as dusk deepened over the countryside. His singing area was in a mixed bed of rushes and lilies, on a lake that lies across a narrow neck of marsh beyond ours. A channel wide and deep enough to permit passage with a small boat connects the two lakes.

Finally, close to the end of June, the night for the bass fishing to open came. There would be fishermen afloat in numbers on both lakes once midnight arrived. They would cover each yard of the reedy shallows before morning, and many bass fishermen are addicted to frog-leg dinners. It is a simple matter to take the kettledrummer at night, with club or spear or snag hook, by blinding him with a flashlight as he sits hunched

in shoal water. He can even be tempted into snapping at a bait or artificial fly dangled on a short line in front of his nose.

Knowing these things, and fearing for the safety of the Old One that night, we decided when darkness fell to organize a rescue expedition. Obviously, we could not hope to save all the bullfrogs in the lake, but perhaps we could save that one. And if we moved him to a dense patch of rushes close beside our boat dock, he might escape molestation and survive the whole summer there.

He was easily located, for the night was warm and he was singing powerfully. We rowed through the channel into the second lake and turned down the shore in his direction, making as little commotion as possible. A few yards from him we pushed the boat into the rushes and turned the bright beam of a flashlight his way. We picked up his big, bulging eyes, shining like twin embers, and the squat outline of his head and shoulders lifted above the water. I shoved the boat in slowly until the stern was within arm's reach of him.

He stopped singing, and just as I leaned down to grab him, he took alarm and crash-dived. But the romantic mood of the evening betrayed him in a curious fashion; he was so inflated with air, as an essential part of his tremendous vocal performance, that he could not stay submerged! He drifted to the surface almost immediately and hunched there beside the boat, a badly handicapped leviathan of a frog, a victim of his own ardent mood, unable to escape but unwilling to deflate.

I scooped him in and we took him home. He spent the night in cramped quarters in a bucket. In the morning we took him to the dock and set him free, anticipating with pleasure his vibrant singing at such close range in the nights to come.

But he had other ideas. He had a home range, a singing area of his own, and he proposed to return to it. The first evening we heard nothing from him. But the evening following, exactly 48 hours after we had captured him, he was singing again as lustily as ever—back in the patch of rushes and lilies in the second lake, where we had heard him first. It had taken him two days, apparently, to travel down our lake, through the channel, and along the shore to his chosen location. That he had made it without mishap was little short of a minor miracle.

He sang there the remainder of the season, but he sang alone. We did not hear the voice of another bullfrog on either of the two lakes again that summer. The fishermen had made a clean sweep, it seemed, that first night. But at least our scheme for the safety of the Old One had succeeded.

The bullfrog comes late from hibernation, the males appearing two to three weeks before the females, and they start singing almost immediately after they emerge. With the end of the breeding season, the kettledrum choir slackens and falls silent. It is heard with decreasing frequency after early July in the north and rarely later than the middle of that month.

On the night of July 13 last summer, one persistent choralist was still singing infrequently, at long irregular intervals and by himself, in our lake. Thereafter, we heard the kettledrummers no more. The hot, dry weather of midsummer and the waning of their courtship ardor had stilled at last June's thundering chorus.

No, not quite stilled, after all. For much to my surprise, on a warm and cloudy day on September 16, a bullfrog sang a few times from the far side of the lake. He managed only two or three desultory notes at a time, as if aware of the futility of such things when summer was dying and his own personal year coming to a close. Yet seemingly he could not quite restrain an inner impulse to set the earth trembling one final time with sonorous music before he retired into winter hibernation.

Bullfrog spawning, like that of most tailless amphibians, in the temperate regions, is governed by water temperature. Not until the water is warm enough for rapid incubation, 60 to 70 degrees, are the eggs deposited. Each female produces from 12,000 to 20,000, laying them in large masses at or near the surface, usually attaching them to submerged reeds or other aquatic vegetation. Each egg, half white and half black, is surrounded by a ball of jelly-like material that binds the spawn together in a squarish mass or wide ribbon. The tiny tadpoles emerge in about four days.

The bullfrog tadpole is a dapper and handsome fellow, straw-colored beneath, brownish-green above, with fine yellow dots over all the body and black spots on the tail. He grows slowly, spending at least two years in the tadpole stage, and he will not transform into adult until the third year if his food supply is scant or other environmental factors are unfavorable. Normally the tadpole is about two inches long when metamorphosis occurs, but in extreme cases he may attain a length of more than five inches before quitting the water for the shore. The transformation usually takes place in July or August. Another five or six years must then pass before the frog reaches maximum size, at which time, if he has lived well, he will boast a body length of six to eight inches, an over-all length of almost double that.

As a tadpole he feeds principally on algae and other vegetation, taking in addition a few small aquatic insects and other animal food. As an adult frog he turns entirely carnivorous, and his taste is cosmopolitan in the extreme. Although his principal fare consists of insects, small crawfish, snails, worms, and spiders, he will take almost anything his capacious jaws can close upon, provided it is not more than his match in one way or another.

Often falling victim himself to a big bass or pike, he does not hesitate in turn to gobble up any fishes small enough to be swallowed. The water snake is one of of his most dread enemies. As often as a suitable opportunity presents itself, he pays his debt to the reptile clan by capturing and swallowing any snake that comes his way and is small enough to be vulnerable. He must live in constant fear of the big, vicious turtles that share his warm-water shoals. Yet little turtles are often found in his own belly. Herons and bitterns are among the deadly perils of his world. He evens the score by pulling under an occasional unwary wild duckling, young coot, or other water bird. He is not above snapping up other frogs smaller than himself.

He lives in a ruthless, murderous world at the margin of pond or lake, a place where marsh and water meet and death can come from overhead or underneath with equal swiftness. The law of that world is eat or be eaten, kill or perish. And for all his warm and vibrant love song, for all his harmless and even dull-witted appearance, for all the benign demeanor of his big protruding eyes and the upturned corners of his wide, comic-character mouth, the bullfrog is without mercy where things smaller or weaker than himself are concerned. He is a cold-blooded and efficient hunter of the shoreline jungles, rush beds, and the lily thickets, as he must be to survive.

But to those for whom the marsh has allure, he is foremost and above all else a musician of early summer that has no peer.

Professional frog hunters, taking him for market and for their own tables, all but wiped him out on the lakes where I knew him long ago, between my boyhood and the time when I returned to that same country years later. But the bullfrogs are making a comeback now, and I am glad. They are a part of the marsh country that should not be lost — sturdy, outdoor characters well worth protecting and preserving. If you have not heard their resonant, sonorous music in the warm and fragrant nights of early summer, you do not know all the fullness of June.

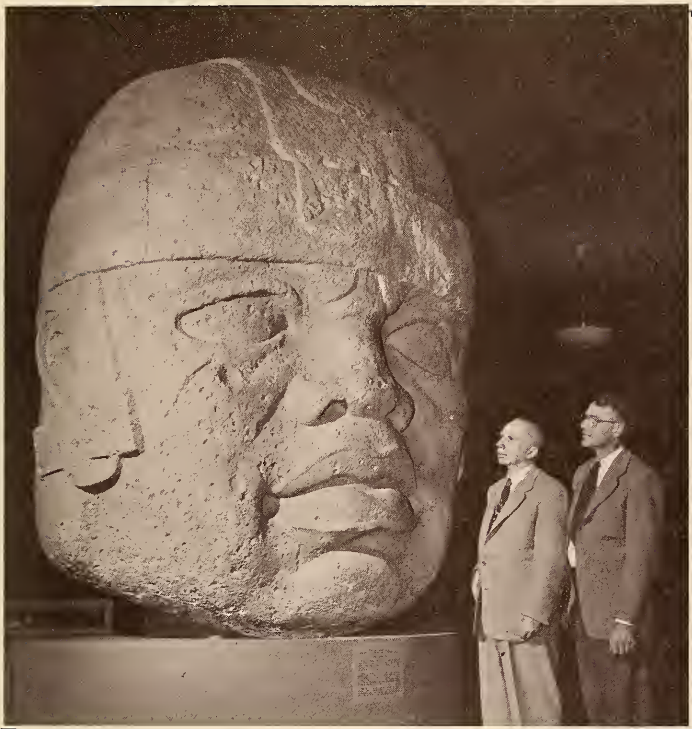
CARPET BEETLES *Continued from page 263*

seum Beetle (*A. museorum*) is one of the few members of the family that shows a preference for dried plants, and its depredations have destroyed many valuable herbarium specimens. Of course, it will also attack most other things that carpet beetles like.

The Furniture Carpet Beetle is a rather recent settler in America, having first landed and become established in this country less than 50 years ago. Its feeding habits are quite peculiar. While it will attack most animal products, it will starve to death on a diet of pure wool. But if the wool is dyed, it can reach maturity. For the most part, it confines itself to the interior of furniture and chairs. Its chief stronghold in America is in Washington, D. C., where it has developed into a serious pest. In other parts of the country, the damage done is sporadic and occurs chiefly in the homes of the wealthy. The Furniture Beetle does not make any effort to select opulent homes; rather, wealthy people unwittingly select the beetle. Almost all the isolated but numerous cases of damage by this beetle have probably been the direct result of importation of antique furniture from Europe or adjacent regions. In the two serious infestations that have come to my attention, this was obviously the case.

The first of these was located in Virginia, where two pieces of furniture were heavily infested. Here, the larvae confined their feeding to the stuffing, and they might have continued to flourish there for many years had not the adults made a nuisance of themselves by coming out and swarming about the windows in an attempt to reach the outside. In this beetle at least, the adults do not need to feed in order to reproduce; they can continue for innumerable generations on the inside of a piece of furniture, the owner entirely unaware of their presence.

The second infestation was near New York City and was extremely severe. Most of the furniture was of European origin. It was not possible to determine when the beetles had arrived in the house, but for several years the adults had been increasing greatly, and at the time the examination was made, thousands of them were present. The larvae had overflowed from the furniture to the rich carpets, which in many places were honeycombed. Beneath many of the pieces of furniture large patches of the rugs had been eaten away. Not a room in the house was free from adult beetles. They were in the furnace room, trying to get out through the glass window, and in a large storage room in the cellar they were swarming over everything. Their breeding place may have been in any one or all of several dozen pieces of furniture. On the first,



Acme

“THE KING”

The largest stone head ever found in the Western Hemisphere

THIS reproduction of the largest carved head ever found in the New World now dominates the Mexican Hall of the American Museum of Natural History. The head is 9 feet high, 6 feet wide, and 20 feet in circumference. It is believed to have been carved at the beginning of the Christian era.

The original head was discovered near San Lorenzo in the state of Vera Cruz by Dr. Matthew W. Stirling, Leader of the National Geographic Society-Smithsonian Institution Expedition to Southern Mexico. In 1947, the American Museum sent Dr. Gordon F. Ekholm, Associate Curator of Anthropology, to Mexico to make arrangements for reproducing it. The head was cast in plaster, and 52 sections were transported from the jungle in river boats and shipped to Mexico City, where 16 large sections were cast. These were shipped to the American Museum's Department of Preparation, where they were assembled and the finished reproduction completed.

The name by which this magnificent sculpture is known, El Rey (“The King”), was given by the native workmen, who were impressed by its huge size. Today the original head still lies in the jungle where it was found. It weighs fifteen tons, and the task of transporting it would be tremendous. One of the mysteries of El Rey is how the ancient people were able to move it nearly 60 miles over rough country from the place where the stone must have originally been quarried.

Living long before the Aztecs, the ancient people of the Olmec country who carved the head may have been contemporaneous with the early Mayas and represented the earliest high culture in the New World. Artists and sculptors who have seen the reproduction call it a great and outstanding work not only of early Mexican art but of any period of culture, particularly since it was carved with stone tools.

second, and third floors, there were dozens of them around each window. The linen closets and other storage places upstairs had their quota.

The amazing thing about this infestation was the relatively small amount of damage that had been done. Had the Black or the Buffalo Carpet Beetles been present in such numbers, there would have been little or no undamaged materials of animal origin left in the house. The condition inside some of the infested furniture must have been appalling, and I have often regretted that I did not open some of it to see just how thoroughly the stuffing had been chewed.

Special Control

In many instances the control of unusual infestations of household insects requires special treatment. Here is an outstanding case of this kind. The problem was to devise a proper kind of spray that would have a number of characteristics. It had to be sufficiently volatile and penetrating so that its fumes could be forced into cracks and crevices and into the furniture itself. It must leave an endurable killing residue. It must not bleach or stain the most delicate fabrics. And it must be fireproof. The last major consideration was safety to warm-blooded animals, including the men and women in the house.

Every commonly used insecticide, solvent, and diluent was considered. A few hours of deliberation with Mr. V. B. Durling resulted in a spray combination that should have all the qualifications desired. Several methods of application were considered, and what proved to be the proper one was decided upon. We had relied upon a lot of theory in evolving the spray. We knew that only a rigid test would prove its value. The logical place to make the test was in the most heavily infested place in the house—the basement storeroom. When, 48 hours after spraying, there was no sign of insect life in the storeroom, and no materials, including many delicate things that had been placed there especially for the test, had been damaged, the rest of the house was treated. The instance cited above is an unusual one, since the infestation was of a rare type.

General Control

All of the methods used for control of clothes moths have been employed in an attempt to prevent damage by carpet beetles, but, unfortunately, carpet beetles are much more difficult to kill than clothes moths. Whereas the clothes moth larvae may be killed by dichloricide fumes in five to twelve days, the beetle larvae may require from ten days to three weeks.

Naphthalene and camphor have little effect on the development of larvae, but these materials do prevent egg-laying.

Cold storage is a big help in controlling carpet beetles, but it does not necessarily kill the larvae. Rather, it drives them into hibernation. Even the Furniture Carpet Beetle can probably survive the winter out-of-doors in the southern half of the United States. The larvae are probably able to go without food, at low temperatures, for as much as six months, and at temperatures above freezing they probably nibble a bit. However, damage at temperatures below 40 degrees F. would be negligible.

Hanging household materials in the sun is usually not very effective. The larvae merely crawl to the darkest and coolest place and stay there until the materials are returned to the house or until the sun goes down. However, if the materials are brushed at the same time, the pests may be eliminated. Frequent examination of stored materials and spraying of the containers, inside, will prevent serious infestation.

DDT, Chlordane, or deodorized Benzinehexachloride (BHC), used in the proper solutions and properly applied, will give protection. I prefer a one per cent emulsion of any one of these, which can be forced by pressure into rugs and carpets and into the cracks of floors and walls. In the treatment of furniture, oil carriers should be used, especially if it is necessary to force the material into the interior of the article to be treated. Such sprays should contain a material to eliminate fire hazard. Fumigation in a vacuum chamber will kill all life in household furnishings that can be so treated, but it will not prevent reinfestation. It is not possible to control well-established carpet beetles with the type of spraying done by the average householder, who makes a few passes with a small gun in a clothes closet or on the surface of carpets. Carpet beetle larvae are tough customers, and it takes a lot more than that. A household gun usually holds a quart or so of spray; to do a real job against the carpet beetle you'll need from five to twenty gallons, and you'll have to apply it thoroughly. If you have carpet beetles in your home, you can figure upon about two gallons for each room, with two or three sprayings a few days apart.

Never spray anything until you have tested the material with a small amount of spray on a very limited area, to be sure that the color will not run or that the material will not bleach. Some of the new paints become spotted or run when certain sprays are used. Fur coats may lose their luster or even their color if not protected from direct spraying. Unless materials sprayed with emulsions, and often with oil bases, are thoroughly clean, they are almost certain to be stained.

There have been many cases where dyed furs and carpets have been ruined by a too liberal application of an oil spray. Usually, when staining results from the use of an emulsion, the stains can be removed by shampooing or surface cleaning. A rich suds is made from any light soap or soap powder; and a soft cotton or woolen rag is wet and squeezed until no water drops from it. The stained areas are then rubbed with light pressure until distinctly wet but not soaking. After a few minutes, the dampened surfaces are once more gone over with a soapless rag that has been soaked in clean, warm water and squeezed until almost dry. This is to remove all trace of the soap, and it may be necessary to repeat the process. If a ring still persists around the treated area, a slightly moist cloth soaked in a weak suds solution should be brushed lightly around the ring of stain, to be followed by vigorous rubbing with a dry cloth until no sign of the ring remains. The cleaned part of the rug will be apparent for a few weeks, but its color will gradually blend with the rest.

I have found that an electric lamp shade treated with DDT is effective against carpet beetles as well as clothes moths*, but it is much slower in its action. Carpet beetle larvae are generally very much more resistant to poisons, and it may be two or three months before they are eliminated from a clothes closet in which the shade is used.

Something to remember: If you mothproof a rug, blanket, or clothing with a water solution, laundering will remove the protective substance. If you use an oil solution, dry-cleaning will remove it.

Insect control in the household is a real problem, but if properly employed it will save money and bring real peace of mind.

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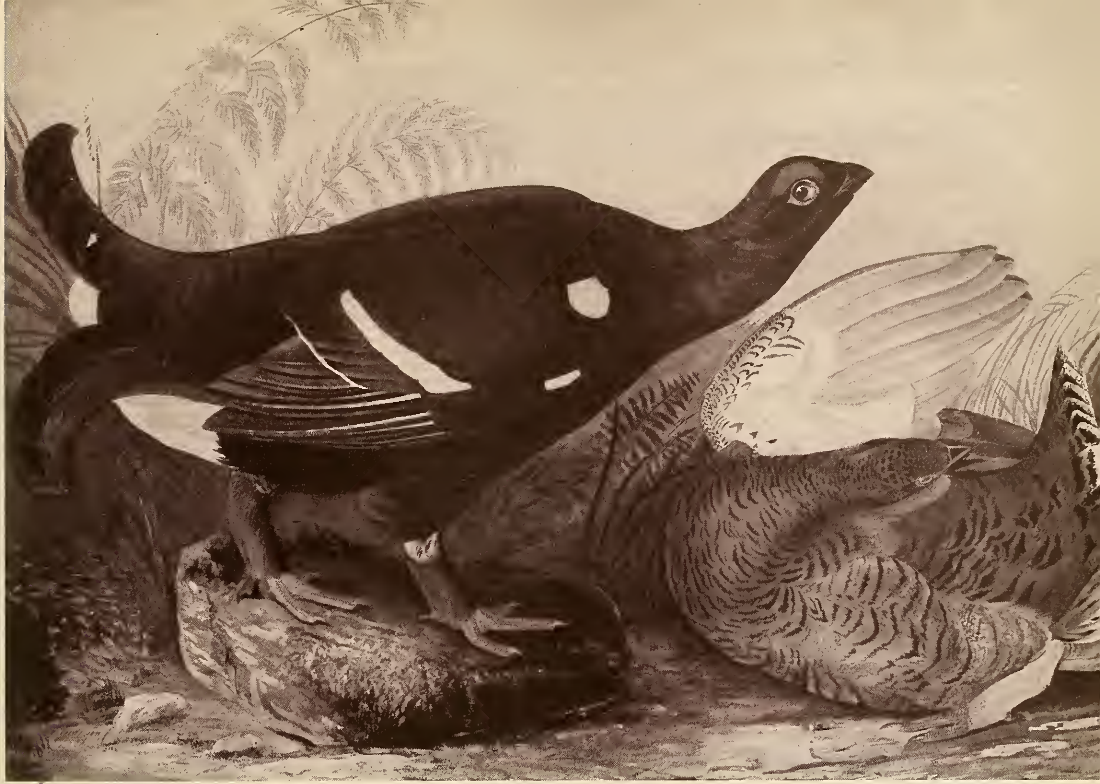
*See "Clothes Moths," by C. H. Curran, NATURAL HISTORY for September, 1949, page 330.



AMNH photo

▲ EUROPEAN BLACKCOCK: an extraordinarily well-composed and stylized water color. In the words of one authority, it makes most of the contemporary bird artists look like amateurs. This painting was completed 122 years ago

An Unpublished Audubon

By HAZEL M. HUNTER

JOHN JAMES AUDUBON was residing in London when he made this water-color drawing of two European blackcock. We believe this to be the first time that this little-known drawing has ever been reproduced. The original measures 18⅝ x 27⅜ inches and is signed at the lower left "J. J. Audubon 1828."

At that time Audubon was working with Robert Havell, Jr. on his publication of *The Birds of America*, and he presumably refers to this drawing in his "Journal" under the date of August 9, 1828, when he states:

"I wished again to try painting in oil . . . and have now before me eight pictures begun, but not one entirely finished. One of these pictures is from my sketch of an Eagle pouncing on a Lamb . . . Another is a copy of the very group of Black Cocks, or Grouse, for which Mr. Gally paid me £100, and I copy it with his permission . . ."

Since acquiring the drawing at an auction held in New York in May, 1949, we have endeavored to trace its history. The former owner was the late Mr. George H. Stuart III of Philadelphia. A member of Mr. Stuart's family very kindly informed us that the drawing was purchased by Mr. Stuart in London in 1924 from Henry Sotheran Ltd. Our inquiry to the Sotheran firm as to when and where they secured the drawing has brought a disappointing reply. Most of Sotheran's old records "were destroyed during the bombing of London," and no present member of that old firm remembers how they came by the drawing.

We like to think that when Audubon made our drawing of the male and female blackcock as well as others of European birds, he had in mind the publication of a series of drawings covering The Birds of Europe, which would be a companion to his now famous elephant folio edition of *The Birds of America*. We do not know what The Great Birdman had in mind 122 years ago except an unending interest in birds. We can be sure of that because his ever-courageous, steadfast, and helpful wife Lucy once admitted in a letter to her sister Eliza, "I have a rival in every bird."

Jumping Fishes

By Bucky McDonnell

WHILE talking to an old-time fresh-water fisherman, I mentioned that I could catch fish without a rod, line, bait, or cuddling. To my surprise, my friend looked perplexed and asked if my method was by traps, nets and snares, or shooting. "You haven't guessed it," I said, "so you probably don't know how to make fish jump out of the water."

The fisherman replied that, although he trusted my honesty, I'd have to show him my magic before he'd believe it. I was surprised that an experienced fisherman had not heard of this simple trick; but several other men who studied fishes scientifically were likewise unfamiliar with it.

I met my friend on the date set for a demonstration and spent the day swimming and hiking around Lake Tiorati, along the Appalachian Trail, where I have a shack. Every now and then he would impatiently ask, "How about the fish jumping out of the water? What are you waiting for?" My answer was the same all day: "There are too many people in the lake." I couldn't tell him why this was important to the success of my method, but I was certain it was. Despite my denials, he persisted in taking this loose explanation as evidence that I wanted to protect my secret.

Finally, evening came, and most of the people and boats cleared off the lake. As we pushed offshore in my canoe, my friend asked if I weren't going to take anything besides the paddles. I laughed, knowing he was sure that I planned to catch the sleeping fish with my hands. I could only assure him that, sleeping or not, the fish would jump and that he would be able to catch them.

I had paddled about three-quarters of a mile out into the lake when I cautioned my friend to be as quiet and as motionless as possible. It was now early evening. The sun was low, and the lake was like a mirror. As far as I could see, we were the only people on the lake.

I paddled hard, making sure not to strike the canoe or move my feet. Then I let the canoe glide to a standstill. I raised my paddle horizontally, about three feet above the gunnels, and then brought it down with a sharp rap across both gunnels at the same time. My friend sat amazed. As many as 200 fishes—pickerel, perch, catfish, bass, and others leaped clear out of the water all around us—some as high as two and a half feet and close enough to be knocked into the canoe. Those closest to the boat jumped the highest.

As I paddled for shore, I waited for a word from my friend. In a moment he said, "Bucky, I will believe anything you say from now on. This is certainly a strange thing. Will they jump again?" We repeated the act on the way to shore, and a few leaped out of the water close to the boat, but the response was not nearly so great as the first time.

My friend believed, as I do, that the sudden vibrations set up in quiet water react in some way on the fish's nervous system, causing the ones near the surface to break through.

My son and daughter have also helped me demonstrate this action to many nonbelievers.

THE FIRST ASCENT OF EL SANGAY

Continued from page 277

millions of tons of ash had encroached on the orifice until it was not over 800 feet in length. Normally the temperature must be colder than the day of our ascent, for not only was the entire rim sheeted with ice, but huge masses of it, as well as snow, had developed on the lower northeast side, and an astonishing amount of huge icicles depended from the overhanging southwestern rim. Other mounds of snow and ice had accumulated far down in the crater at points where the heat was less intense.

I pointed my camera into the cavern and waited a half hour for the gas to blow to one side, in order to record the curious ice hummocks extending into the depths as far as visibility might permit. The northeastern rim of the volcano was broken down for a distance of 200 feet. Through this portal, lava undoubtedly had poured at some period of the past and plunged down the steep slope into the Amazon basin three miles below. We made a circuit of the rim to the northeastern break in the wall. Here the descending knife-edge had frozen solid and proved too steep for snow to collect. We dropped toward the bottom of the crater by straddling and sliding but could not go far because of the gases.

On this lower side the beauty of the orifice reached maximum. Across the vortex rose the sheer wall we had just left. Its rim bulged with overhanging ruffles of snow, outlined sharply against the indigo sky. Below were the ebony walls of ash, patched with snow areas. Out of the depths at our feet, its base lost in the swirling gases, rose a strange formation, which rounded out into a perfect white chrysanthemum 50 feet in diameter and of unknown height. Its foamlike top glistened in the rays of the western sun. Interesting as was the gas-veiled floor of the crater, exquisite as was the frosted rim and the "chrysanthemum," nothing could equal the sublimity of the ice formations which had reared like blown spume of the sea over the southeast margin. Fantastic shapes predominated, huge and chaotic. As we faced to the north a simultaneous exclamation of astonishment broke from the lips of all. In the distance, ten degrees east of north, two gigantic fingers had etched themselves in glittering white above the billowing cloud masses. From the summits of her great candles, the unclimbed mountain El Altar had witnessed the conquest of her far-famed rival.

Climbing for the most part on our knees, we reascended the frozen eastern knife-edge to the northeast rim. A sudden blast from the prevailing east wind blew the Shroud back momentarily over the Labyrinth to the west and exposed one of the longest, almost perpendicular descents in the world—over three miles. The mystery of the constant renewal of the Shroud was revealed before our startled eyes. Far down in the superheated Amazonian cauldron, white puffs like mushrooms were continually forming. Humid currents of air were being forced upward by the tendency of heat to rise. Ascending the 18,000-foot slope, they entered the frigid atmosphere about the ice fields. The contact of heated currents with freezing temperatures results in rapid condensation, and clouds are born in a moment before the astounded eyes of the climber. This process keeps up for days, the ever-oncoming masses joining the Shroud to the west and constantly recreating it. The new clouds congeal on the slopes and thicken the collar of snow and ice. When El Sangay blows off its cap, the ice field dissolves rapidly, and the Labyrinth at its base is choked with a stupendous deluge of water and ice cascading down the precipitous sides. The flood boils and churns in the gorges, and masses of ash, catapulted out of the crater, choke the canyons and destroy every vestige of plant life. Indians who have ventured too far to obtain their delectable tapir are then caught in a trap. But the roots of the formidable sword-edged plant known as "paja" survive on the crests of knife-edges between the canyons and soon reclothe the ridges and plateaus with formidable clumps, two to five feet high.

We dared not linger longer! At 4:50 P.M., we said farewell to the inner rim. Then did the mountain witness a sight that would have delighted the hearts of the Scandinavian gods. In a gesture of exultation, the boys threw themselves into a glissade down the steep southwest slope. As their sliding, prone forms took on speed, momentum whirled them down the ice, and they disappeared in the flung spume of the snow. In 30 minutes they reached the fiala tent, a distance that had required 5 hours and 10 minutes to cover on the ascent!

The rest of the descent under the Shroud and the return to Alao were accomplished without much difficulty. The party suffered considerably from a continued diet of raw venison and sugar. Two of our Indians, while trying to recover the tent and equipment from the snow line on a midnight of storm, fell off a knife-edge and were rescued in a hysterical condition by Terry and Lewis. The rivers in the Labyrinth had risen above their previous flood levels but not sufficiently high to prevent threading a course through the canyons. Thenceforth the peons treated us as heroes and helped to make the return easy for the "Mad Americans" who had braved the wrath of their dreaded Demon. *We* dreaded far more the incessant rains, which continued unabated day and night, until we finally emerged from the cloud to the Valley of the Alao, there to lie prone for one hour of ecstasy under the balm of our own god—the Sun.

Only twice had the Shroud been rent during the return, once on Dorado Mountain at the twilight hour. It was the final view of the mountain we had learned to love. The last shafts of sunlight had long left the valleys, when the Shroud parted and revealed the God of Snows in a mood of sublime ecstasy. He had girdled his thighs with a band of royal purple and his chest with an ermine collar. But his head stood clear in the afterglow, flushed with beneficent gold. El Sangay was putting all the kindliness of a majestic being into one last farewell.

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BOOKS

Continued from page 245

Walton; he recounts the whimsical behavior of trout, he expounds upon the appeal of various lures, and finally he describes how trout should be cooked. Surely, every office-bound reader will wish to follow the example of Justice William O. Douglas.

H. E. Anthony

NATIVE ARTS OF THE PACIFIC NORTHWEST

Introductory Text by
- - - - - - - - - Robert Tyler Davis

Stanford University Press, $7.50
166 pp., 194 photos, 5 color plates, 1 map

IN recent years one notes an ever-increasing tendency on the part of art museums to recognize the carvings and paintings of the Northwest Coast Indians as representing one of the world's great art traditions. It is gratifying, therefore, that so handsome a publication should have been devoted to this subject, heretofore largely unknown to students of the fine arts. In this photographic album, the first of a series of art books projected by the Stanford University Press, the fantastic productions of the Northwest Coast artist-craftsmen stand on their own merits and speak eloquently for themselves. The unity and uniqueness of the North Pacific tradition is immediately apparent, and it contrasts strikingly with the few Eskimo examples that have been included. In addition, Dr. Davis' text, though brief, is pertinent and provides the cultural setting against which the objects take on added meaning.

Nearly all of the examples illustrated were selected from the collection made by the late Axel Rasmussen of Skagway, Alaska. Considering the money, time, and effort expended on this lavish volume, it seems a pity that the editors should have so limited themselves, however outstanding this body of material may be. One result is that certain of the major classes of wood sculptures—house posts, grave monuments, and the so-called "totem poles"—receive almost no representation. Another is that some tribes, particularly the Tlingit and Kwakiutl, are emphasized at the expense of others, while certain important groups like the Nootka are not represented by a single specimen. In addition, although most of the objects have considerable eye appeal, some pieces are simply not of the highest caliber. The present album, however, is a significant contribution in the field of fine arts. The careful documentation, as well as the fact that the collection has not been illustrated previously, should make this volume of interest not only to the layman but to the professional anthropologist.

H. T. Tschopik, Jr.

LETTERS

Continued from page 242

nervous, and after my last shot he took off through the trees at a fast walk.

Jack W. Lentfer.
Livingston, Mont.

° ° °

Sirs:

Congratulations on the Fiftieth Anniversary of your distinguished publication, Natural History, and best wishes for every continued success . . .

Jorge A. Lines.
San José, Costa Rica

° ° °

Sirs:

. . . I want to congratulate the Museum most sincerely on the Fiftieth Anniversary of the Magazine, and the Editor on the article, "It's for You to Choose." . . . When you pass near the Hayden Planetarium, you ask yourself perhaps the same question as Nick Kenny:

> "How can you look at a sky
> full of stars
> And say there is no God?
> How would the flowers know
> it was spring
> Except for a smile from God?"

This is felt by all humanity, be it "black, white, yellow, red, each in his Maker's image." It is high time to reach out and give a helping hand to each other . . .

W. Deininger.
Puerta La Laguna,
El Salvador

Important Notice

Readers are reminded that Natural History is not published during July and August. Those who expect to be away after September 1, however, and wish to have their September issue sent to a temporary summer address are requested to notify the Membership Secretary. Please give also the date of expected return to permanent address.

° ° °

Sirs:

I have read with interest that Natural History has been in existence 50 years. I send you my best congratulations and most respectful greetings. If men studied nature profoundly, we would have no wars and would praise God for his ingenious works . . .

Eduard Espenshied.
Ludwigsburg, Germany

° ° °

Sirs:

. . . Your splendid editorial, "It's for You to Choose," . . . is an excellent presentation and very thought-provoking.

Irving M. Ives,
Senator from New York
Washington, D. C.

° ° °

Sirs:

. . . As a member of the Museum for many years, I take pleasure in congratulating you on the Fiftieth Anniversary of your excellent publication . . . I think that your editorial "It's for You to Choose" was one of the finest things I have read in my life, and of course I am saving it . . .

Anthony V. Ragusin, *Sec.*
Biloxi Chamber of Commerce
Biloxi, Miss.

The Planetarium Show

"Color in the Sky" will be the subject at the Hayden Planetarium during June. The presentation will include the northern lights, rainbow coloration, and related phenomena.

During July and August, visitors to the Planetarium will take an imaginary trip to the Moon by space ship. Landing in a lunar crater, the audience will explore its many strange wonders and view the earth from a new point of perspective in space.

Special Exhibits at the American Museum

Until June 16

Second Annual Exhibition of The New York Entomological Society.

June 9—July 4

Design Down Under

An exhibition comprising 22 photo mural panels dealing exclusively with the art and design of the Australian aborigines. Shields, bark paintings, tattooing, baskets, flint knives, axes, clubs, bull-roarers, sacred stones, paddles, and headdresses are some of the many kinds of designs shown.

June 15—July 30

National Soap Sculpture Exhibition

July 7—July 31

Old Flower Prints

A collection of old botanical prints assembled by Kennedy and Co.

eptember **NATURAL HISTORY** 1950

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Now Ready!

AUGUST ON FIRE ISLAND BEACH

BY ROBERT CUSHMAN MURPHY

(*author of* LOGBOOK FOR GRACE)

This new enlarged edition was published again by popular demand. Dr. Murphy combines an effortless style, grace of manner, and sympathetic understanding of natural history in all its relational aspects. Among other subjects, the author discusses:

Point o' Woods

Its unique charm and simplicity almost within the shadow of Manhattan's skyscrapers.

Beetles and Biters

The insect population on Fire Island with emphasis on tiger beetles and stable flies.

The Turbulent Life of the Sand Bug

Being an interesting history of the life and times of *Emerita talpoida.*

Dr. Murphy concludes with a plea to save Fire Island and other untouched primitive territories so that city folk can "dwell in the presence and appreciation of the beauty our ancestors found here."

You will be a richer person after reading

AUGUST ON FIRE ISLAND BEACH

Science Guide No. 134 *Price, 40¢ plus 5¢ postage*

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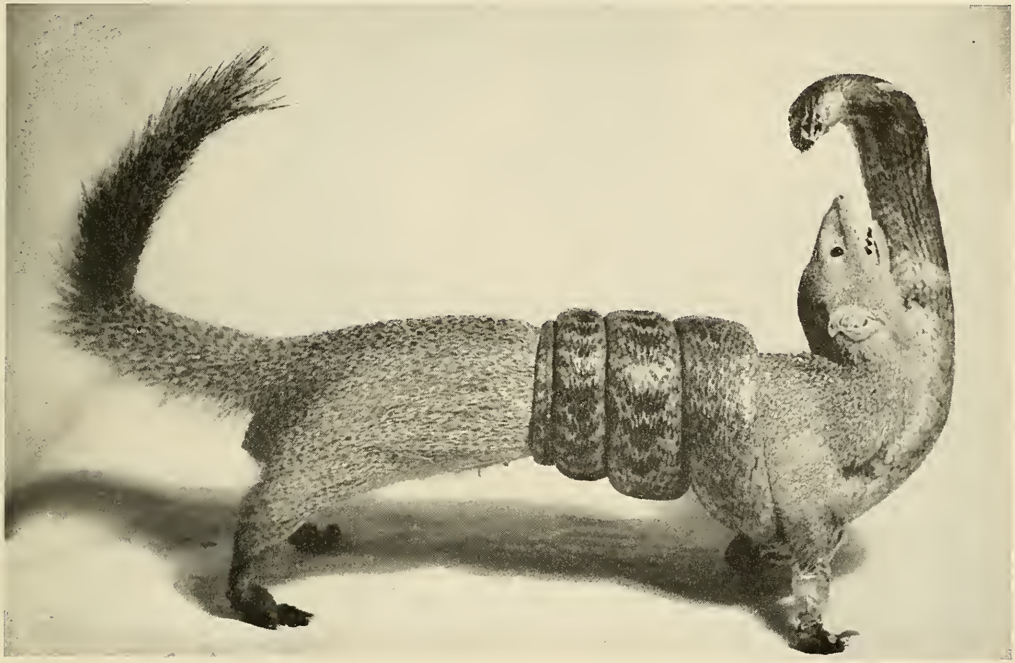


The Mongoose and the Cobra

SIRS:

I would like to know whether the pose depicted in this photograph of a mounted mongoose and spectacled cobra could ever happen in real life. This exhibit is in our Quaker Hill Museum of Natural History at Pawling, New York, and I have seen published photographs of at least one other similar mounting. As the cobra is a poisonous snake, why should it wrap itself around the mongoose? And how could the mongoose be standing firmly on its feet with a snake wrapped around its middle? I suspect that these specimens are the product of an imaginative taxidermist.

Also, what is the plural of mongoose? And is the mongoose always victorious?

MRS. R. M. GUNNISON.
Pawling, New York.

The following answer is offered by Charles M. Bogert of the American Museum's Department of Amphibians and Reptiles:

Mrs. Gunnison's comments on this mounting are quite to the point. I have seen a similar picture elsewhere, in which the snake's neck was firmly grasped in the mouth of the mongoose. The caption read, "Victorious mongoose polishes off a cobra," but the photographer had quite obviously trained his camera on a mounted specimen.

In the course of combat, a coil or so of the cobra may accidentally be wound around the body of the mongoose. Indeed, one of Dr. Thomas Barbour's photographs in his interesting little book, *Reptiles and Amphibians, their Habits and Adaptations,* depicts the live mongoose lying on its side with two coils of the cobra encircling it, one near the legs and the other near the head. Even were the cobra a constrictor, it would be unusual, to say the least, for it to wrap four or five coils around an attacker. Boas, bullsnakes, and kingsnakes that kill by constriction rarely employ more than two or three, and the hind part of the body and the tail are not ordinarily wrapped around an adversary. The positions of the snake and the mongoose in the photograph must therefore be attributed to the fanciful but misguided notions of the taxidermist.

The mongoose may kill an occasional cobra, but it does not seek out such prey. It devours birds, their eggs, lizards, and insects. While he was in China, Clifford Pope tested the behavior of the mongoose and the cobra on two occasions. Once he used a five-foot snake and a small mongoose, and later a three-foot cobra and a large mongoose. When placed together in a small room, each animal apparently regarded its opponent with considerable caution, concentrating its attention on the other. In both tests, the mongoose attacked the cobra at the moment it struck, biting at the snake's open mouth. The jaws of the two were repeatedly interlocked, although the mongoose sometimes avoided the relatively slow strike of the cobra by merely shifting its head.

The small mongoose failed to kill its enemy. However, Mr. Pope knew that the mongoose was in a weakened condition when brought to him, and it died the second day after the fight. The larger mongoose killed the smaller of the two cobras and showed no ill effects from the encounter. During the combat it repeatedly approached the cobra and then lay on its side just beyond its reach. In this position, it kept its vision fixed on the snake, raising its head from time to time to keep it in view—"a most peculiar and inexplicable behavior," as Mr. Pope remarked.

Is the mongoose always victorious? Under some conditions in captivity it obviously is not. In its native habitat, it probably does not often attack an animal it cannot subdue. On occasion, an acute hunger drive may lead it to abandon its normal caution. But most animals, whether from learning or instinctively, are not ordinarily prone to attack the sort of prey that cannot be overcome. Mistakes are doubtless made, however.

The plural is "mongooses," not "mongeese." These animals belong to an Old World family related to the weasels, badgers, and skunks. What is usually spoken of as the common mongoose inhabits southeastern Asia, from southern China to India. Closely related animals are of widespread occurrence in Africa, and some of these are called mongooses. Incidentally, it may be added that, owing to their destruction of game and poultry, a law has been passed many years ago prohibiting the importation of live mongooses into the United States.

Can Birds Tell Time?

Sirs:

I wonder if the English sparrows in my city garden have a sense of time. About a year ago, I discovered that they like to eat rice. Since then, I have scattered a small amount of rice grains just outside my kitchen door each day around noon. While at other times I occasionally see a single sparrow hopefully searching in the feeding area, there is a distinct difference at noon. Then, as I look from the window, there are always several sparrows watching near by, apparently aware that it is feeding time. There is a restless excitement and expectancy among them. At the sound of the kitchen door opening, they all fly a little farther away, but as soon as I have put out the food and entered the house, a dozen or more return immediately and begin feeding eagerly. In a short while the feast is over, and the entire flock flies away until the next day near noon, when the performance is repeated.

Can birds tell time?

Henrietta Schroeder.

Woodhaven, N. Y.

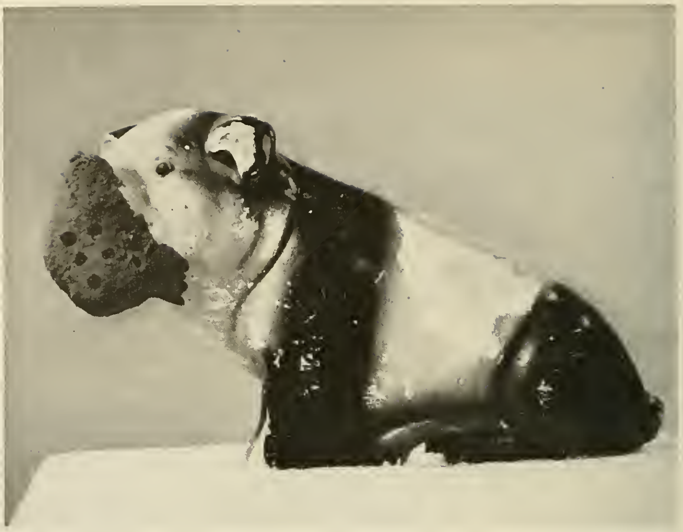
The following comments are offered by Dr. John T. Zimmer, Curator of the Department of Birds at the American Museum:

There is little doubt that birds have what, for want of a better term, may be called a sense of time that can operate to induce some particular action at a certain point in a daily rhythm. Many of a bird's activities are governed by such automatic trigger mechanism. A rhythm is established in which various related activities follow each other in regular order. Each completed stage presents a new stimulus that releases the following reaction until the cycle is completed. If the order is broken or interrupted, the bird may be quite confused, perhaps perform some useless action whose normal stimulus is suggested by the situation, or perhaps go back and start over. This type of behavior is particularly noticeable in the activities of feeding the young, where the same maneuver is repeated at frequent intervals. These do not, however, necessarily involve any fixed time of performance.

Other activities may, on the other hand, have a fixed time-release. A tropical wren was recorded as beginning its morning song at a relatively fixed time, and although the intensity of light may have had some influence on the release, it was far from governing the action. Again, a male pigeon has been reported as accustomed to relieve his mate at the nest at ten o'clock each morning. The habit was so fixed that when the female was killed by a cat the male neglected the young (which consequently died from exposure) until his scheduled hour the following day.

The sparrows were, in effect, trained to being fed at a particular time of day, and an internal rhythm had become established with reference to food at that period in the day's activities. Whatever the internal mechanism may be that would spring the alarm, when the signal was given, the proper action followed quite automatically.

There is a nice opportunity for someone to make a detailed study of timing by birds, and the results would be of considerable interest. As far as I know, no one has yet concentrated on the problem.



A Lesson for the Laggard

Sirs:

The accompanying picture shows an unusual-looking animal that I discovered on a shelf in my garage. The little pig had been tucked away on the shelf for some time, and you can imagine my consternation when I first glimpsed the decorations that had been added by a mud-making wasp.

Laura M. Clark.

Tulsa, Okla.

Suet-storing Nuthatches

Sirs:

Last winter we became much interested in observing a White-breasted Nuthatch that had been coming to the crotch of a sugar maple tree next to our house where we had been placing a piece of suet. On New Year's morning, we noticed that the Nuthatch was picking into the suet quite freely, and when it had a full beak, it would deposit this

Continued on page 336

WILD BIRDS ADD *Charm* TO YOUR GARDEN

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VOLUME LIX—NO. 7 **SEPTEMBER, 1950**

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An ancient patriarch that saw a conqueror weep and lived to symbolize his sadness

Lungless Salamanders ....ROMEO MANSUETI 300
Only recently has it been known that many of our familiar salamanders live without lungs or gills

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THE COVER THIS MONTH

The Tarascan village of Angahuan is now the nearest populated community to Mexico's new volcano Parícutin. The wooden homes with their steep shingle roofs are typical of the region. The people are a happy, friendly lot, whose co-operation has gone far toward making the joint Mexican-American study of the volcano a success. For the little girls, the burdens of motherhood begin as soon as they are big enough to carry little brother or sister in the *reboza*, which is the usual attire of Mexican girls and women.

The people of Angahuan have been hard hit by the eruptions of the young volcano. Repeated ash falls have smothered the crops in the fields and killed the grass on which the cattle grazed. Though unspectacular, their plight is serious. Cultivation of the slopes from which the ash has already been washed is only hastening the day when further erosion will make it no longer possible to raise food near the village. While they would undoubtedly cling to their homes as vigorously as did the residents of San Juan and Parícutin, resettlement may ultimately be their only solution.

FREDERICK H. POUGH

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By
JOHN L. LACEY

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The life history and a complete, accurate description of every bird to be found east of the Dakotas, Nebraska, and Kansas; it includes Florida to the south, eastern Canada to the north.

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BRAZILIAN CULTURE

- - - - by Fernando de Azuevedo

The Macmillan Co., $12.50
562 pp., 418 illusts.

IN this era of overworked superlatives, the adjective "monumental" is unquestionably employed too loosely and too often. Yet no other word seems suitable to describe this vast compilation of Brazilian culture history. First published in Portuguese, in 1943, as the introductory volume to the 1940 Brazilian census, the study is conceived on a grand scale and executed with admirable scholarship.

The book is divided into three parts: (1) the Factors of Culture—the environmental and human setting; (2) Culture—the Brazilian achievement; (3) The Transmission of Culture—the history of, and current trends in, education in Brazil. Although the author—a noted sociologist and educator—is thoroughly familiar with the accepted and all-inclusive anthropological concept of culture, he prefers to employ the term in its classic, restricted sense as applying to "refinements of intelligence." In essence, therefore, the book is a study of the origin, growth, and change of intellectual values, ideas, arts, and scientific achievement in Brazil. Only incidentally is it concerned with the material aspects of Brazilian economics and technology.

Following the French sociologists, it is the author's contention that the "genius" of a people receives its fullest expression through its educational system. A third of the book is thus devoted to a historical analysis of Brazilian education as a key to an understanding of the Brazilian "collective character."

Although certain portions of the study seem thin, the author evidences a keen sense of history as well as a tolerant awareness of the multiplicity of factors operative in cultural evolution. All things considered, the book should prove an indispensable addition to any library dealing with the peoples and cultures of Latin America, and it is likely to remain one of the most significant syntheses in the field of Brazilian culture history for many years to come. The illustrations are fascinating for their number and variety, and the index is excellent.

HARRY TSCHOPIK, JR.

THE COMING OF THE MAORI

- - - - - - - - - by Sir Peter Buck
(Te Rangi Hiroa)

Whitcombe and Tombs, Christchurch, New Zealand, 30/, 542 pp., 24 plates

IN this massive book Sir Peter Buck brings to a climax a lifetime of research, which began in a loving exploration of the culture of his mother's people and extended into many other Polynesian cultures. Sir Peter's work has always been distinguished by the liveliness and humanity which he was able to bring to the details of basket making or mat making, fishing or housebuilding. The material aspects are traced with the greatest accuracy and detail, but they are always accompanied by comment on their meaning in the lives of those who weave and fish and build. This interest in material culture has been paralleled by a deep appreciation of the poetry and mythology of the Polynesians. Taken together, the details of technology and the romance of long voyages, the final settlement and faithful preservation of the records make an impressive work, combining scholarship, field work, historical passion, and sensitive insights into one of the most fascinating groups of people of which we have any knowledge—the Maori of New Zealand.

MARGARET MEAD

OUT OF MY LATER YEARS

- - - - - - - - by Albert Einstein

Philosophical Library, $4.75
290 pp.

ALTHOUGH the pieces that make up this book were written at various times and for various occasions, they have an unexpected unity and cohesion which the range of subject matter would not at first suggest. Many of them are less than a page long, few are more than five or six; they cover personal, scientific, social, political, and biographical matters, and the final section deals with a subject close to Einstein's heart—the Jews. Yet, from this apparently formless assemblage of exhortation, analysis, and comment, there emerges the unifying impression of a human portrait—a self-portrait. For out of the reading of Einstein's reactions to the world of science and to the affairs of men, the reader builds up a picture of Einstein himself that shines forth and grows in luminosity as one continues to read.

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Here is a man who writes in all simplicity and with utter sincerity. Since he writes what he feels deeply, what he says is an important part of his spirit. It is a great personality that takes form, one that is deeply concerned with the welfare of mankind and is ready to stand staunchly for the truth as he sees it. A world organization in the form of a supranational state is his answer to the fears and insecurity of the world today.

Einstein's deep faith in tolerance expresses itself again and again in pleas for an acceptance of human differences. Let our children grow up free to express their creative urges most fully, and let us cheerfully and willingly permit nations and groups to develop in their own way.

To those who think of Einstein as an austere and remote mathematician, this book will reveal a warmer, more human person. Here is a wise, gentle, firm man who has thought hard about the human predicament and has much sage advice to give.

HARRY L. SHAPIRO

YANKEE'S WANDER WORLD

Circling the Globe in the Brigantine Yankee

- - - - by Irving and Electa Johnson

W. W. Norton and Company, $5.00.
277 pp., 21 full-color photographs,
58 black-and-white.

TO circle our globe by plane is costly and not very educational. The Johnsons have a better method; they make it possible for their fortunate companions to visit places inaccessible by plane or steamer. These sea-going educators have a ship both beautiful and practical; the crew learns as it goes. What experience they gain in 18 months! What strange places and peoples they visit!

Commander Johnson devotes one chapter to this new *Yankee*, a 96-foot brigantine with auxiliary Diesel engines, and 7,775 square feet of canvas. His wife contributes many of the other chapters about their fourth cruise around the world. Merely to pick a congenial crew required rare insight. The first mate must be a competent officer; a doctor and a good cook were essential. In addition there were about ten young men of varied tastes and skills, age around 20 preferred, and four young women not much older. The Johnsons' sons have been seafarers since babyhood.

The *Yankee* set out from Gloucester early in November, 1947, and a very brief sampling of her stopping places includes Haiti, the Galápagos, Easter Island, Pitcairn, the Tuamotus, Tin Can Island, the New Hebrides, New Guinea, Bali, Keeling Cocos, Zanzibar, St. Helena, and Devil's Island. From the coasts of South America, Asia, and Africa, trips were made into the interior. Old friends were encountered in odd places, many new friendships formed.

At Pitcairn the Johnsons are loved and admired. The Governor of St. Helena proved to be an old friend from the New Hebrides. Commander Johnson's war service aided greatly; he knows the places best suited for study. Through days fair or foul, and some serious storms, the *Yankee* sailed on with its crew of enthusiasts. Knowing the Johnsons will show you why. This admirable book, beautifully illustrated, cannot be too highly commended.

James P. Chapin

FISHPONDS AND AQUARIUMS

- - - - - - - - - - by Ian Harman

Sidgwick and Jackson, Ltd.,
44 Museum St., London, England
128 pp., 33 illusts., 6/

THE author of this small book writes well and apparently has had a good deal of firsthand experience with fishponds and home aquaria for goldfish and other inhabitants of temperate water. He also possesses the ability to organize his material and present it in logical sequence. But no man should suppose that he knows nearly everything about any field of endeavor, and although Mr. Harman undoubtedly would be the first to agree with this dictum, his book unfortunately seems to indicate this kind of overconfidence—or else a lack of appreciation of the host of errors that inevitably creep into the best of factual manuscripts.

His book is marred by entirely too many small misstatements of fact and orthographic errors—mistakes that could have been eliminated had any wide-awake biologist checked the work. Why do so many popular books show such disregard for the virtue of accuracy? The final responsibility surely lies as much with the publisher as with the author.

With most of the practices and techniques outlined here one would have no quarrel. A few, however, are quite contrary to this reviewer's experience: charcoal has little, if any, effect on the gas content of water and therefore can serve little purpose in a pool or aquarium; breaking the ice over a garden pool is a dangerous practice and hardly ever necessary to avoid smothering the fish; feeding as often as twice a day almost inevitably leads to overfeeding with all its concomitant evils; plants do not oxygenate the water in small pools or aquaria to any appreciable extent and are thus not essential for aeration.

This is, by and large, a satisfactory but undistinguished addition to the growing literature on fishponds and aquaria.

James W. Atz

A BIRD PHOTOGRAPHER IN INDIA

- - - - - - - by E. H. N. Lowther

Oxford University Press, $5.50
162 pp., 79 plates

FOR 34 years Mr. Lowther has been photographing and taking notes on India's rich and varied bird life. From time to time some of the results were published in the *Journal of the Bombay Natural History Society*, but this serial publication is not readily available, and they are republished here, revised and in greatly augmented form. Half of the illustrations are new.

This book is not just another of those beautiful albums of beautiful bird portraits presenting mostly common species. It has much more merit. In addition to the photographs, of which there are 151 depicting 114 species, the text gives much valuable information on nests, eggs, courtship, food and feeding, and other behavior. Many of the birds at their nests had never been photographed or shown before. All the pictures are valuable, and many of them are striking. The reader may not realize that all this was obtained the hard way. In the region covered (parts of Bengal, Bihar, and the United Provinces) and at the season these pictures and observations were made, the temperature reaches 140 degrees F. The conditions in a cramped and stuffy blind must have been appalling.

This reviewer has but one regret—that in a book of definite value such as this one, scientific names are used but once. This, however, detracts in no sense from

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the popular appeal of the book which, as the jacket claims—for once too modestly, it seems—"is possibly the best collection of Indian bird photographs so far assembled in any book."

Charles Vaurie

PLANT DISEASE HANDBOOK

- - - - - - - by Cynthia Westcott

D. Van Nostrand Company, $7.50
746 pp., 111 figs.

HERE is the book for which those of us with small home gardens have been waiting! It is a splendid compendium of 1500 diseases of 1000 common native and introduced trees, shrubs, vines, grasses, garden flowers, and vegetables grown in home gardens, orchards, parks, and parkways anywhere in the United States. Each disease is described, and control measures are discussed. There are elaborate indices of the diseases and their causal organisms; the host-plants are listed with cross references to all the diseases known to attack each plant, and so are the garden chemicals and commercial products used in the treatment of plant diseases. There is even a very gratifyingly up-to-date classification of the pathogens. In the section in which all the diseases known to attack a given host are listed, the distribution of the disease over the country is indicated by the names of the states in which it has been found or by such terms as "general," "widespread," "occasional," etc.

In order to keep the book small enough and sufficiently reasonable in price for the ordinary garden, orchard, or greenhouse owner, the diseases of field crops (such as wheat, rye, oats, barley, rice, and cotton) have been omitted, but corn and the various vegetables likely to be found in small gardens are included. There are 111 excellent photographs and drawings to illustrate the well-written text. The typography and format are excellent for easy readability and quick reference. A selected bibliography of 135 of the most important books, pamphlets, and articles on the subject is included, and the text is filled with suggestions as to where the reader may obtain more information.

THIS AD IS WORTH $10

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This is by far the best book this reviewer has yet seen for the quick detection of diseases caused by bacteria, fungi, viruses, nematodes, and nutrient deficiencies, and their control.

H. N. Moldenke

POPOL VUH The Sacred Book of the Ancient Quiché Maya English version by Delia Goetz and Sylvanus G. Morley from the Spanish translation by Adrián Recinos

University of Oklahoma Press
Norman, Okla., $3.75, 267 pp.

THE *Popol Vuh* is one of the best of the written documents to have come down to us from pre-Columbian America. It is the sacred book of the Quiché Maya, a large and important branch of the Maya who lived in the highlands of Guatemala but who shared in the unsurpassed civilizational achievements of the lowland groups. Concerning the mythology and traditional history of the Quiché (the creation of the earth and of man, the history of the gods and of the rulers of the Quiché nation), it is a completely native chronicle expressing with apparent fidelity the mode of thought of this advanced American Indian people.

Although the *Popol Vuh* has been widely known for many years through various published editions in Spanish, French, and German, this is, surprisingly enough, the first complete edition in English. Translated from the recent Spanish language edition prepared by the Guatemalan scholar Adrián Recinos, it is most adequately documented with footnotes and with an excellent introduction concerning primarily the history of the document from the time when it was first written down in the Quiché language, but in Latin script, at about the middle of the sixteenth century.

This fine English edition of the *Popol Vuh* should be welcomed by all those interested in the history and philosophy of the American Indian civilizations who have been obliged to wait for an English translation.

Gordon F. Ekholm

EARLY MAN IN THE NEW WORLD

- - - - - - by Kenneth Macgowan

The Macmillan Company, $5.00
260 pp.

THE history of man and culture in the New World falls into two conventional halves—the earlier Indian phase and the post-Columbian European phase. The reconstruction of the prehistory of America has been a long, arduous, and often exciting adventure. And no part of that enterprise has been more controversial than the problem of dating the first settlement of man in the New World, the origin of pre-Columbian populations, and the existence of cultural influences from the Old World. Opinions on these subjects have undergone radical revision periodically. We are now, as a result of a long series of recent discoveries, in such a season of re-evaluation. With the bars down, speculation has tended to run riot, and some of the fanciful ideas generated by this new freedom can only be taken as by-products of a silly season.

Fortunately, Mr. Macgowan has written in *Early Man in the New World* an excellent introduction to the whole subject, assembling most of the significant evidence, presenting the various and often contradictory deductions, and maintaining, on the whole, a well-balanced attitude toward the competing claims.

In general, Mr. Macgowan's position on many controversial points seems to be a little left of center. He accepts Hooton's and Gladwin's hypothesis that an Australoid or Melanesoid strain antedated the more classic Mongoloid Indian in America. He is significantly open-minded to evidence suggesting trans-Pacific influences on native culture; and, although guarded on dating these early migrations, he is not hostile to the opinions that would place these events further back than the end of the last glaciation.

Harry L. Shapiro

INTRODUCING THE INSECT

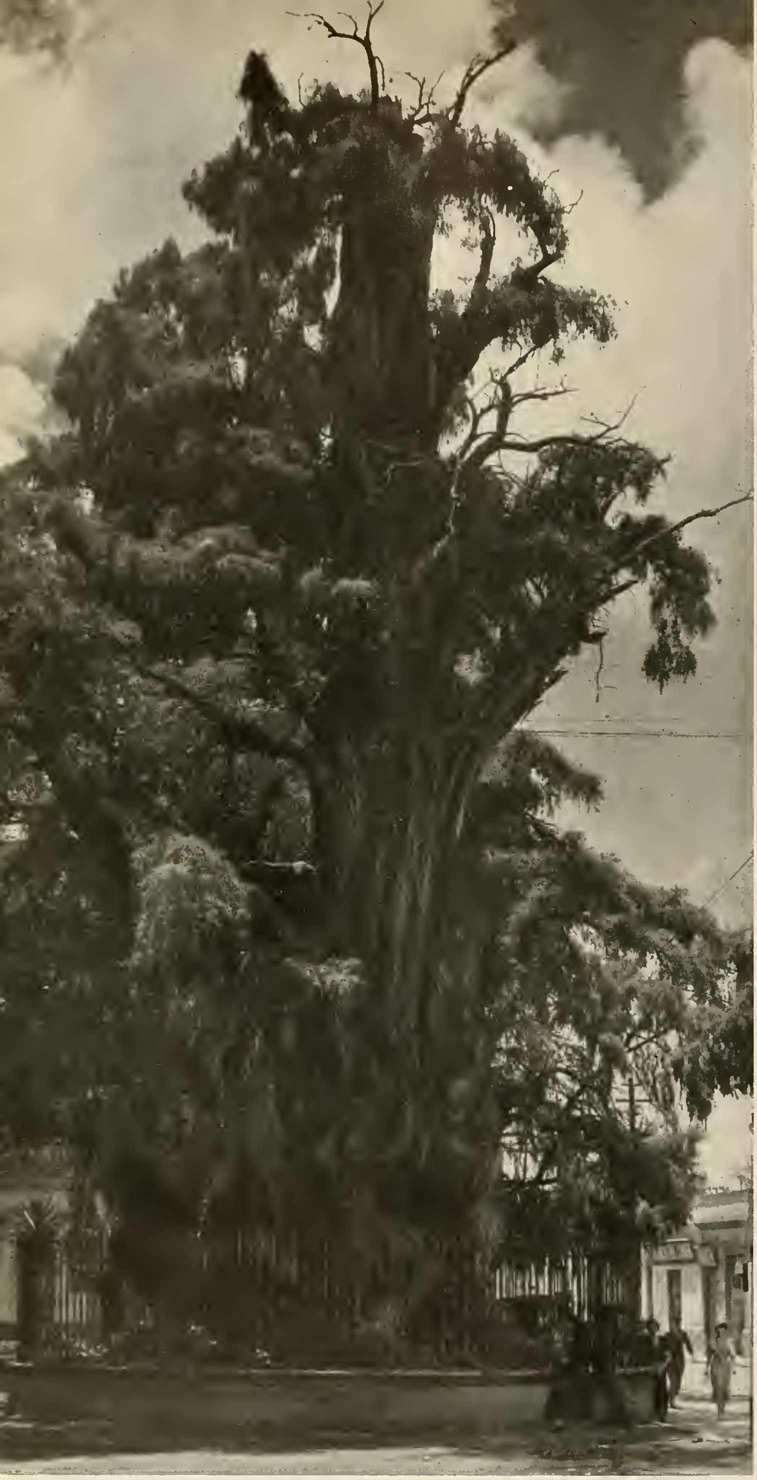
- - - - - - - - - by F. A. Urquhart

Henry Holt and Company, $5.00
287 pp., 160 figs., 4 color plates

BECAUSE of the enormous number of different kinds of insects, anyone who attempts to introduce them to the general public can do so only in a sketchy manner. He must select those that are most often seen by the public or that have an unusual appeal because of unusual habits. It is always difficult to select the most suitable examples because different kinds of insects are found in different parts of the country.

Dr. Urquhart has selected types that are very widely distributed in North America, and many of these occur also in Europe and other parts of the world. He has prepared simple, illustrated keys to the orders and to the families of the larger orders, such as the bugs, beetles, bees and wasps, butterflies and moths, and the true flies. Because of lack of space, a few of the less important orders and many families are necessarily omitted. The chapter on making a collection from the beginning to the completion of preparation for scientific study or exhibition will be found most helpful, while the chapter on anatomy and life history

Continued on page 334



▲ A BATTERED SURVIVOR of five centuries of history: the "Tree of the Sorrowful Night." Under this tree, in 1520, Cortes mourned the most crushing defeat sustained by the Spanish in the New World

“Tree of

IN a crowded suburb of Mexico City, in the thick of the clangor and uproar of a great metropolis, stands a gnarled, broken old monster of a tree that gives every evidence of having as many lives as a nimble-witted cat. More lives, in fact; for who ever heard of a cat living upward of 500 years? This battered veteran of the centuries is intimately associated with the history of the Spanish conquest of Mexico, and it bears the melancholy title of "Tree of the Sorrowful Night."

The years have dealt harshly with the tree. Its crown is gone, its branches are splintered, its interior is as hollow as a smokestack—so hollow, in fact, that another tree grows within the main trunk. Yet this gutted giant clings grimly to life, putting forth new leaves and greeting each succeeding spring like an inspired pillar of faith.

The legend that gives the tree its doleful nickname is one of the most colorful in Mexican history. Hernando Cortes paused under the tree during his withdrawal from Mexico City in 1520 and wept for the blow fate had dealt him. Half of his army had been lost in the battle. Gone were all the guns and most of the treasure. Cortes, who had labored for hours to keep the retreat from turning into a rout, sat under the great cypress weeping for the dead and for the loss of Mexico City.

Cortes' Mexican campaign had been a disastrous one. Although having forced themselves into the center of the city, Cortes and his army were unable to gain control of an increasingly hostile populace and decided to retreat to safer ground. Mexico City stood on an island in the center of a lake. It was reached from the mainland by an elaborate system of causeways and was protected by warriors on foot and in innumerable canoes. The solidly constructed causeways were wide enough for several horsemen to ride

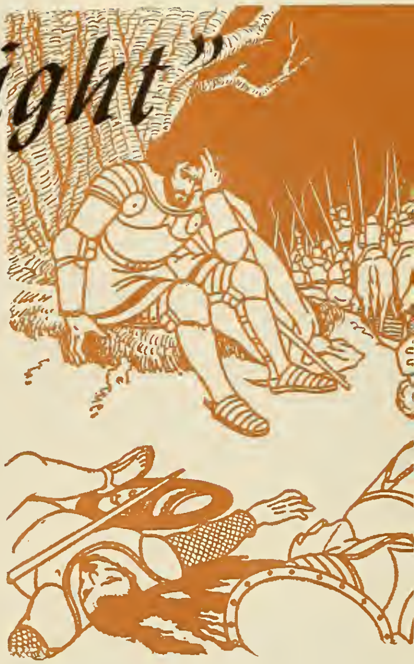
he Sorrowful Night"

An ancient patriarch that saw a conqueror weep and lived to symbolize his sadness

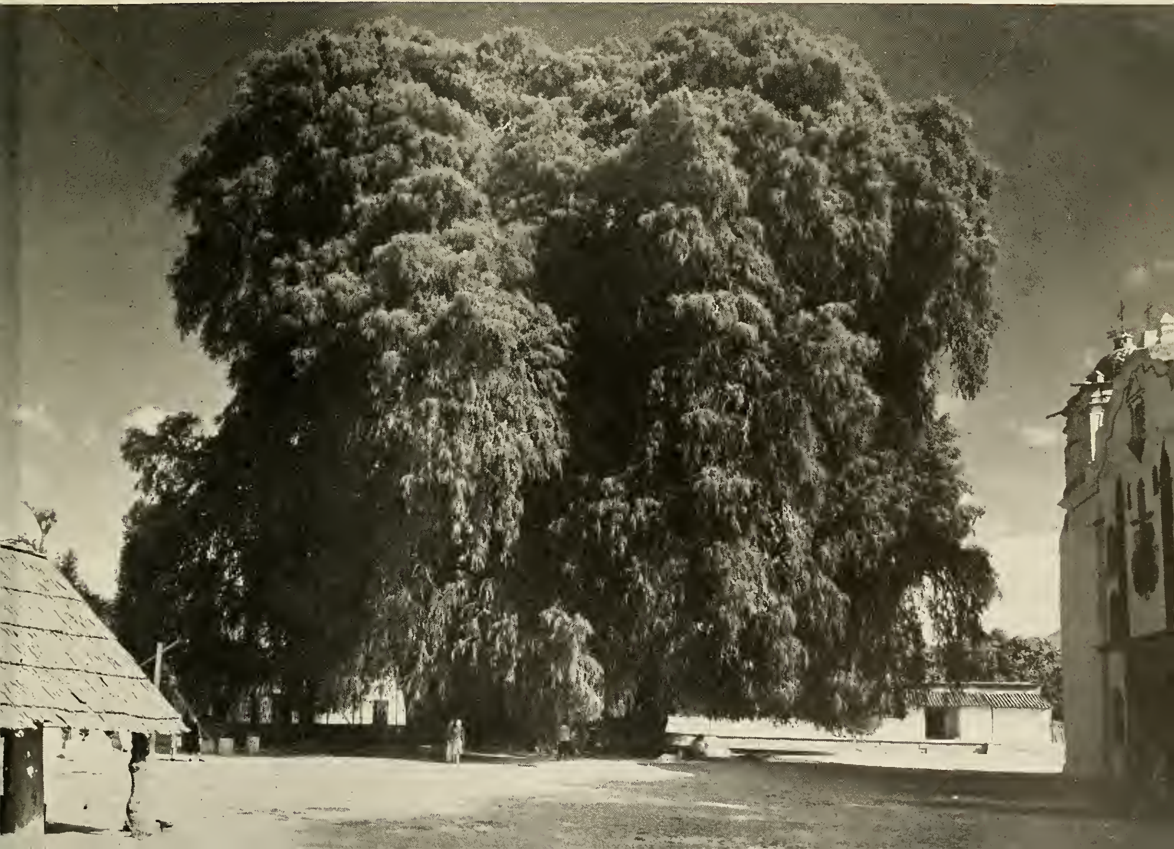
By Philip Ferry

abreast. With so many hazards surrounding their escape, the Spaniards were like rats fighting their way out of a trap.

The Spaniards planned to evacuate their position under cover of darkness, and at midnight on June 30, 1520, they began the soul-breaking march from Mexico City—"the scene of so much suffering and such indomitable courage," as Prescott phrased it. Each soldier carried as much gold as he could; Cortes and his captains took the lead, followed by the squadrons carrying treasure and baggage. As the Spaniards reached an open breach in the causeway and were in the act of laying a portable bridge across the gap, they were discovered by the sentinels.



From Alfonso Teja Zabre's *Guide to the History of Mexico*, Mexico, 1935



▼ "Tree of Tule"—the oldest, largest, and most celebrated tree in Mexico. Some Montezuma cypresses are said to be at least 3000 years old and are obviously the remnants of a great tropical forest that once covered the valley of Mexico

o by Kodak Mexicana Ltd.

Photo by Cia Mexicana de Aviacion

▲ Typical Mexican street scene. In many parts of sunny Mexico the Montezuma cypress is sought as a shade tree

The alarm was sounded, the city was roused, and thousands of vengeful Aztecs came swarming over lake and causeway.

The Spaniards were set upon from all sides. The battle raged the length of the causeway, the breach being soon filled with equipment and the bodies of men and horses. The fighting continued throughout the night, the hard-pressed Spaniards battling desperately like cornered animals. With dawn, the survivors managed to fight their way to the mainland. As they streamed by and rallied on a slight rise to the west of the city, the exhausted commander dismounted and gazed sorrowfully on the broken remnants of his army.

What a sad spectacle they presented! Gone was the treasure and hundreds of their comrades. The exhausted cavalry, most of them afoot, dragged themselves wearily along, their shining armor battered, their elaborate raiment and crests dripping with water, their proud banners gone. Cortes looked at his thinned and disordered ranks. Though accustomed to control his emotions, the sight was too much for him. Covering his face with his hands, he gave way to tears.

It was the worst defeat sustained by Spanish arms in the New World. That night of disaster, which took half of Cortes' army, was branded "La Noche Triste" (The Sad, or Melancholy, Night), while the tree that was the scene of his sorrow became similarly known as El Arbol (The Tree) de la Noche Triste.

This tree under which Cortes bemoaned his unhappy fate (although a year later he was to succeed in reducing the city) was a giant Ahuehuete, as the Mexicans call it, or Montezuma Cypress as it is also known (*Taxodium mucronatum*, the *Cupressus disticha* of Linnaeus). It belongs to a family of conifers and is related to the deciduous American bald cypress in the United States. Appropriately enough, the tree has always been a symbol of mourning and sadness. In ancient times its branches were used at funerals and to adorn tombs.

Because of the tendency of the branches to spread horizontally, the tree has always been sought for its shade. In the even climate of the Mexican highlands the species attains great age, with a tremendous over-all spread of branches and enormous size, as is evidenced by some of the specimens in the forest of Chapultepec Park in Mexico City. Perhaps 200 of the old ahuehuetes remain in the park. Some are declared to be at least 3000 years old and are obviously the remnants of a magnificent tropical forest that once covered the great valley of Mexico.

Although the trunks of some of the trees are enormous—the Montezuma Tree, largest in the park, has a circumference of 45 feet—decay has eaten into the heart of many of the patriarchs. In this respect, the ahuehuete seems to lack the invulnerability of California's sequoias, which are capable of living not only

centuries but millenniums without decay.

The Tree of the Sorrowful Night is one of the largest ahuehuetes known. I stepped off the circumference of the tree and estimated the girth to be something over 60 feet, which would give it a diameter of around 20 feet—a giant by any standards. Even in Cortes' day it was a wide-branched centenarian offering welcome shade to a good-sized detachment.

Cortes seems to have had a special fondness for these giant cypresses, and there are three associated with his name. During the early days of his advance from the Atlantic coast to the valley of Mexico, he stopped at the Indian village of Tlatlauquitepec and remained several days to rest and refresh his troops. Modern Indians have long pointed out the venerable *Arbol Grande* to whose branches the Conqueror hitched his horse.

The third of the giant cypresses connected at least in legend with Cortes' Mexican campaigns is today the oldest, largest, and most celebrated tree in Mexico. It is the great Tree of Tule, or Arbol del Tule, as the Mexicans call it, a giant cypress standing in the churchyard of Santa Maria del Tule (Holy Mary of the Bulrushes) about six miles from the city of Oaxaca, in southern Mexico.*

Cortes has been dead these 400 years, having flashed through Aztec history like a thunderbolt across a summer sky. The great ahuehuetes that marked his advance in the New World still flourish. Coursing through the fibers of these indomitable patriarchs seems to be some of the iron that flowed through the veins of Cortes. Where the Spaniard conquered a people, these trees have prevailed over time—a vastly greater achievement.

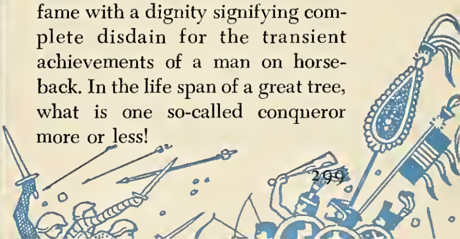
The Tree of the Sorrowful Night has shown in its resistance to time the same hardihood and unyielding stubbornness that Cortes displayed in the face of repeated disaster. Fanatical Indians attempted to burn it three-quarters of a century ago. As a result, it is so hollow that one wonders what keeps it upright. Actually, it is a mere shell. Patched and wired like an ancient Model-T Ford, it looks as if it would prove an easy victim to one of the strong winds that sweep across the plain of Mexico. Yet it goes on living, providing welcome shade for the picturesquely costumed peons who seek the shelter of its spreading branches and massive trunk.

In recent years science has come to its rescue with the latest advances in tree surgery. By removing the dead matter from the interior and plugging many of the worst holes with concrete, by painting the open wounds with a veneer of preservative and by stopping up many of the gapping holes in the lower trunk, it is hoped that the noble old veteran's days will be prolonged.

Today the Tree of the Sorrowful Night forms the central feature of a tiny neighborhood park in Mexico City, and all commercial tours of the city include a visit to the tree. Children crawl over the knobby body, swing on the gnarled protuberances, and run in and out of the gutted interior. Surrounded with all the hubbub of a large city, hemmed in by a few square feet of greensward, and identified incompletely by a sign that now carries only the single word *Arbol*, it looks exactly what it is: a survivor of the past and a memento of a time when the great plain of Mexico echoed to the tread of mailed conquerors.

One cannot say that history retains any particular veneration for the memory of Cortes or special glory for his dubious achievements; but history can have nothing but admiration for a weather-beaten, gutted old patriarch of a tree that goes on living and sending out green leaves like any lusty young seedling. The natives know Cortes only as a legend; they live intimately with this giant cypress that bears its years and fame with a dignity signifying complete disdain for the transient achievements of a man on horseback. In the life span of a great tree, what is one so-called conqueror more or less!

▼ **Like sentinels** at the gate, these cypresses seem to guard the slumber of the mighty volcano Popocatepetl



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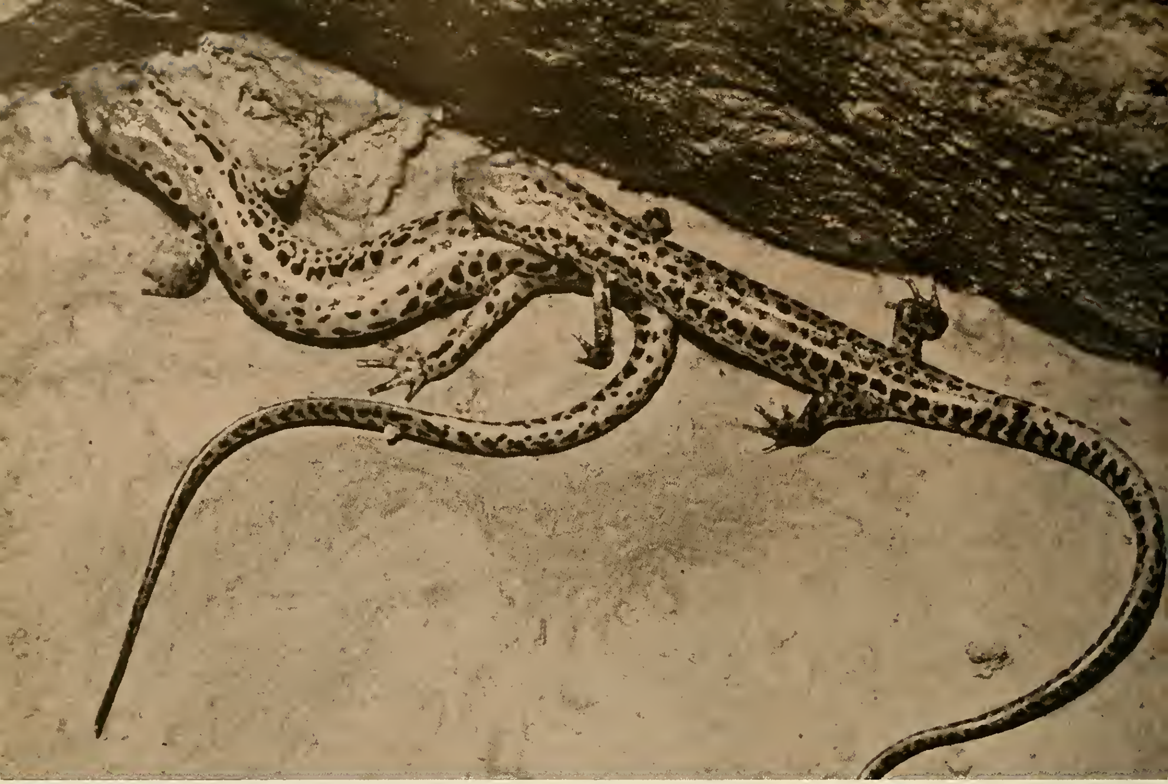
*See "A Methuselah among Trees," by Walter Henricks Hodge, Natural History for May, 1948



Charles E. Mohr ph

▲ THE TAIL AMOUNTS TO about 60 per cent of the total length of the long-tailed salamander, *Eurycea longicauda.* Most salamanders of this genus perform an elaborate courtship ritual. The male massages the female's chin with the top of his tail, as shown here

LUNGLESS *Salamanders*

For centuries it was not realized that many of our familiar salamanders live without lungs or gills

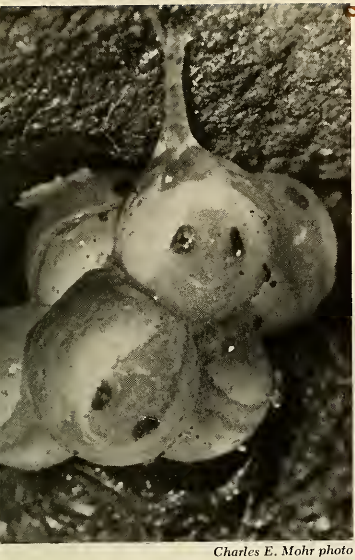
By ROMEO MANSUETI

THE year 1894 is not famous for extraordinary events, but a small group of zoologists may recall it for the minor sensation caused by a fellow-worker, Professor H. H. Wilder, of Smith College in Northampton, Mass., exploded the bomb by announcing in the staid periodical *Anatomischer Anzeiger* the discovery of "*Lunglose Salamandriden.*"

"Lungless salamanders" seemed such a curious phrase that a flurry of comment followed the announcement. Professor Wilder spoke of these four-footed, tailed amphibians as neither possessing gills nor lungs in the adult stage—a most unorthodox situation. Many biologists simply scoffed at the statement. Others wanted to know how their blood could be oxygenated. And amateur naturalists put the question simply: "How can the darn things breathe?"

Influential, erudite Professor Edward Drinker Cope, America's veteran comparative anatomist of that period, stated unequivocally that he had been dissecting salamanders most of his life and had always found lungs in them. Nonetheless, Cope's colleagues found that he was mistaken in the case of the salamanders of the large family Plethodontidae, all of which proved to be lungless.

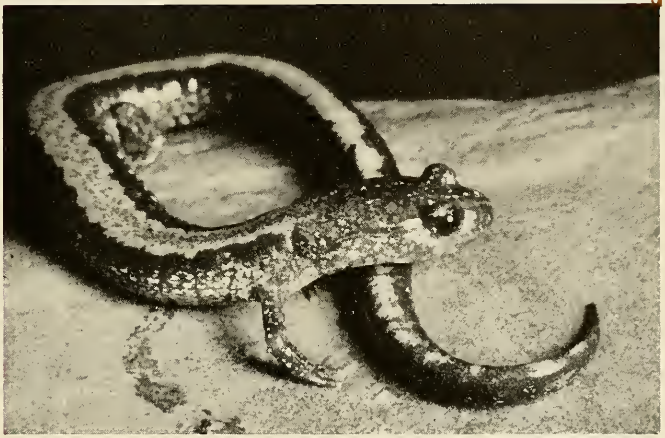
This important and very surprising fact had not been observed or suspected up to that time, although these animals had been studied by numerous investigators both in America and Europe. True, a German embryologist, Heinrich Rathke, had first noticed the absence of



Charles E. Mohr photo

◄ Eggs of the Red-backed Salamander, *Plethodon cinereus.* The big dark eyes of the salamander embryos show clearly through the transparent gelatinous cases. The eggs are one-fifth inch in diameter, and after two months of incubation, the young, nearly an inch long, will emerge. These eggs are generally found in crevices in decaying logs, but this grapelike cluster was found suspended from the underside of a flat stone

▼ The Red-backed Salamander, *Plethodon cinereus,* which emerges from these eggs, lives completely away from the water and can withstand a great deal of dryness. It is a small salamander—only about half the size shown here



August Selckmann photo

lungs in the worm salamander, *Batrachoseps attenuatus,* as early as 1833. But it was Professor Wilder who first demonstrated that the lack of lungs was normal and widespread among these curious and colorful creatures. Even today, very few people imagine plethodontid salamanders as freaks of nature.

Elfs and goblins are the acknowledged but mythical inhabitants of the forest, but the plethodontid is the only genuine sprite of the woodland within reach of many naturalists. When discovered by the novice in its natural habitat, its smooth and shiny body, augmented by brilliant hues and striking patterns, gives the illusion of a jewel gleaming in the dull earth or mud. Delicate, as if created by the careful craftsmanship of a glassblower, these miniature amphibians are commonly found in springs, along streams, and even on land. To find them, one must overturn rocks and logs, plunge a hand into ice-cold springs, and suffer other inconveniences. Despite their apparent abundance, few people ever see them, for many are rather secretive and are apt to be clever escape artists.

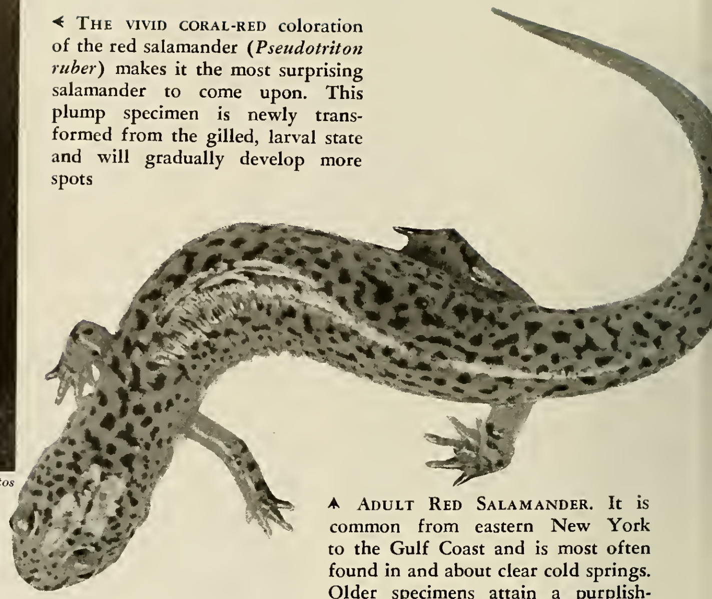
Among the celebrities of this family of salamanders, the common red salamander, *Pseudotriton ruber,* is an excellent example of a brilliantly-colored species commonly found over most of the eastern United States. When uncovered from beneath a rock in a spring, it strikes one as being too startlingly vermilion to be a natural part of the countryside. On the other hand, its bright hues might easily frighten some nature lover who associates venomous qualities with such a gaudy creature. Of course, the red salamander is not poisonous; all plethodontids are perfectly harmless. Contrary to the principle that the coloration of most amphibians matches their surroundings fairly well, the red color of *Pseudotriton* seems to defy explanation on a basis of protection. Rather, these tints are like those of the leaves in autumn—beautiful but without value.

In the same class as the red salamanders, the long-tailed salamander, *Eurycea longicauda,* reigns almost as champion by having a record-length tail. The tail of an adult is about one and a half times the length of the fragile-looking body. But the very rare Alaska worm salamander, *Batrachoseps caudatus,* sports an even more splendid tail, which is almost twice the length of the body of the adult. The long-tailed salamander is yellowish-orange, with a series of black spots along the sides of the body. Adults are found mainly in and beneath old rotting logs and under flat rocks adjacent to streams. It is also a cave dweller. When a flashbeam plays upon it in such surroundings, it looks like some strange and beautiful specter.

Juvenile long-tailed salamanders and their relatives breathe by means of externally visible staghorn or bushy gills, the three branches arising from a common

Charles E. Mohr photos

◄ The vivid coral-red coloration of the red salamander (*Pseudotriton ruber*) makes it the most surprising salamander to come upon. This plump specimen is newly transformed from the gilled, larval state and will gradually develop more spots



▲ **Adult Red Salamander.** It is common from eastern New York to the Gulf Coast and is most often found in and about clear cold springs. Older specimens attain a purplish-brown color, with numerous irregular spots. Adults average five inches in length

base. These merely lie exposed to water currents. The water bathes the many fine filaments, which are covered by delicate epidermal membranes that contain blood channels, and the exchange of oxygen and carbon-dioxide gas occurs between the blood and the water. Larval salamanders display aquatic adaptations before metamorphosis; but shortly before the pre-adult stage, the gills and fins atrophy and the dull larval hues change as if by magic to vivid colors. It is at this stage that plethodontid salamanders exhibit their peculiar anatomical individualism.

When the external gills disappear, normal "breathing" presumambly stops because of the absence of lungs. Plethodontids continue to "breathe" as adults, nevertheless, but in their own strange way. Even in other families of salamanders, the lungs are now considered to serve chiefly for regulating buoyancy rather than as respiratory organs. The utilization of certain marvelous breathing mechanisms compensates for such a great loss. First of all, plethodontids depend largely upon skin respiration. The blood is aerated through the very thin and constantly moist epidermis. Tiny blood vessels that penetrate to the surface of the skin carry on the vital oxygenation. Secondly, the lining of the mouth is very vascular and also serves as a respiratory organ.

With such specialized structures for "gulping" or "sweating" for air, one might expect the activity of lungless salamanders to be restricted to imperceptible movements. On the contrary, most species are very active in their particular habitat. Some of the dusky salamanders of the genus *Desmognathus* are truly water acrobats when stirred.

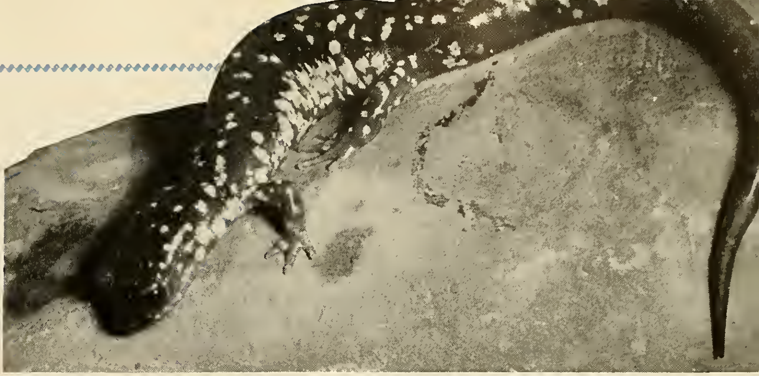
Brooks are the "sanitariums" for many lungless salamanders. Swift-running, gushing streams are highly oxygenated, hence a perfect home for a lungless animal. Lungs having a hydrostatic function would obviously be of no particular advantage in swift currents, so their loss in that sense is no sacrifice.

All amphibians are cold-blooded, including, of course, the plethodontids, but they do not suffer in their cold aquatic environment. Bitter-cold water in winter and anything short of freezing cannot lull the salamanders into hibernation. Many are active all winter.

A home on dry land might seem to be most uncomfortable for a lungless salamander, but many of them live in such situations. Landlubbers, such as the slimy salamander, *Plethodon glutinosus,* and the red-backed salamander, *Plethodon cinereus,* surely possess a special mechanism for resisting desiccation. Such species usually do not go near water. They lay their eggs in little cavities in logs or humus, and the parents often brood them. Possibly the female remains with the young after they hatch, not to protect them from enemies but to prevent them from drying by keeping her moist body in contact with theirs. Salamanders, by and large, are not better endowed than some fishes in their ability to learn or remember, and few of the behavior patterns found in higher animals can be ascribed to them.

As in all animal groups, certain "personalities" stand out more than others. The purple salamander, *Gyrinophilus porphyriticus,* might be called Public Enemy No. 1 of the plethodontid world, because it is

THE SLIMY SALAMANDER, *Plethodon*
utinosus, is noted for its use of a sticky
ilk-white slime to escape from its en-
ies. The substance is not poisonous to
in, but it leaves a mucous deposit on
e's hands that is difficult to remove when
dries



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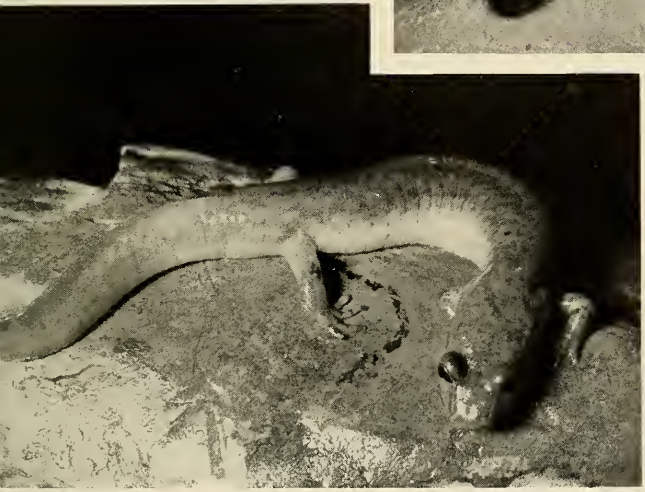
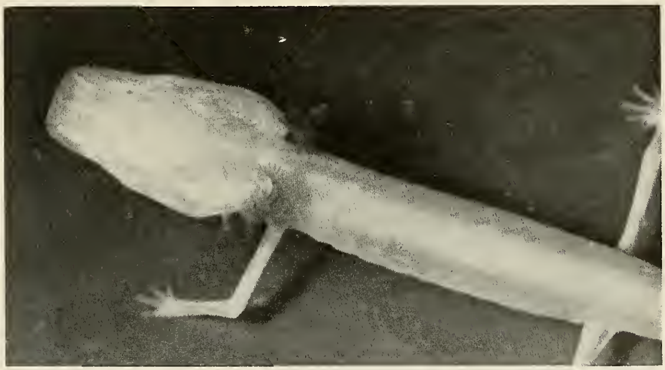


August Selckmann photo

◀ DESPITE ITS NAME, the Purple Salamander (*Gyrinophilus porphyriticus*), is a salmon-colored creature. It is the cannibal of the salamander world, since it eats closely related salamanders and even its brothers and sisters. Its mating season is in the autumn, contrary to the schedule of most other wild animals

▼ THE TEXAS BLIND SALAMANDER (*Pyphlomolge rathbuni*) never "grows up." That is, it never outgrows its larval habit of breathing through external gills. It is a rare inhabitant of underground streams in the Edwards Plateau, Texas. It has pin-point eyes beneath the skin



Charles E. Mohr photo

a confirmed cannibal. It is a suave, salmon-colored fellow that lives in very cold springs. It has been known to devour such close cousins as the four-toed, two-lined, and dusky salamanders, and it may even eat unlucky brothers and sisters. It also feeds upon aquatic insects, crustaceans, and even frogs—yet its total length is only six and a half inches.

It is in the autumn that the young male purple salamander's fancy lightly turns to young females. After an elaborate courtship involving a wrestling dance, eggs are laid in flat masses beneath stones in flowing water. Perhaps the eggs are brooded, but this is not definitely known.

The slimy salamander's chief claim to fame is its ability to exude a viscous, milk-white slime when it is seized by an enemy. It is a shiny creature, looking much like a licorice stick sprinkled with sugar. Its slime is harmless to man, but it is not soluble in water and is difficult to wash off when it dries. Perhaps it affords protection from other animals but not usually from a determined person.

Houdini never left an arm or leg behind after one of his spectacular escapades, but the slimy salamander will frequently part with an entire tail in order to remain free. If you grasp the creature by the tail, it will voluntarily twist it off. But you need not feel sorry, for the salamander will grow another in its place. A slimy's tail is used as a brace against a rock or burrow in the event of an attack.

If prizes were given for speed in disarticulating the body from the tail, the four-toed salamander, *Hemidactylium scutatum,* would easily take first place, because it has a curious constriction at the base of its tail. Four toes on each foot, rather than four on the front and five on the hind feet, set this salamander apart from other members of the family. The courtship proceedings in autumn consists of a series of what we might call "osculating" antics, during which the male applies his lips, cheeks, or the side of his body to the snout of the female. Courtship culminates when the female follows the male, keeping her chin closely pressed against the base of his tail. The male, especially when he is not moving forward, undulates the base of his tail from side to side. He deposits a sperm capsule, which is taken up by the cloacal lips of the female, and the eggs are subsequently fertilized. In spring the female retires to a nest or cavity in sphagnum moss at the water's edge. She occupies these little openings in the moss and rests *upside down,* grasping rootlets and bits of moss with her feet while slowly forcing the eggs out, one at a time. The process has been described by Dr. Sherman C. Bishop, America's famed salamander specialist. Laying eggs upside down is a common procedure among a large number of plethodontids. In fact, anyone who studies them carefully will note many curious modes of reproduction, feeding, and other habits.

The strangest plethodontid is a ghostlike creature dwelling in the caves and underground passages of the limestone region in the Ozarks of Missouri. This blind salamander, *Typhlotriton spelaeus,* has functional eyes as a larva, during which time it lives chiefly near the mouths of caves. But during metamorphosis it penetrates deeply into caves, and soon the lids draw together, fuse in part, and the light-sensitive rods and cones of the retina disappear. Scientists have found, however, that if the young metamorphosed blind salamander is subjected to the stimulus of light, it will develop functional eyes. Two other grotesque-looking blind salamanders are known, one from Texas, the other from Georgia, and they live in the netherland of wells and subterranean streams.

The lungless salamanders must really be considered more American than the American Indian, in the sense that the salamanders arrived first. Only one major family, the Salamandridae, is supposed to have existed when a connection between Europe and America was available in the early Eocene, 50 or 60 million years ago. When the continents separated, the American Salamandridae took to the mountain brooks of the Appalachians and took on plethodontid characteristics. The plethodontids are a much younger group, therefore—speaking in terms of millions of years—than some of the other families. They later became terrestrial and migrated to western North America and South America—all in a period of several million years. Even today the southern Appalachians have the largest concentration of lungless salamanders.

There is one puzzling species, the Mount Lyell salamander—a salamander with a European cousin. This salamander, *Hydromantes platycephalus,* made its debut into the scientific world by wandering into a mousetrap at an elevation of 10,800 feet in the Yosemite National Park. Since then, this Alpine salamander has attracted a great deal of attention because we find it so far removed from its nearest relative. A single related species is found in Sardinia, the French Alps, and part of northern Italy. How the two species can have become so widely separated, with the Atlantic Ocean in between, has been hard to explain. Dr. Emmett Reid Dunn, the brilliant student of lungless salamanders, has considered the *Hydromantes* a relict genus. He reasons that the genus must have traveled from America to Europe by way of Greenland and Iceland, since no more southerly route is known to have existed during the period under consideration. Another possible explanation is that these salamanders crossed from North America to Asia by means of the Bering Strait connection, which is known to have existed much more recently than any

Continued on page 332

Early "

Some of the

IN the fall of 1924, a workman, Mr. M. de Bruyn, blasting out rock in a limestone quarry about six miles from the little village of Taungs in South Africa, discovered a remarkable skull. He took it to be a fossil Bushman skull and showed it to Mr. Spiers, the manager. Mr. Spiers sent it to Prof. Raymond A. Dart, of the Witwatersrand University.

This Taungs Skull, as it came to be called, was one of the finest fossil human or prehuman skulls ever discovered. It was uncrushed and was beautifully preserved on one side. All the deciduous teeth and the permanent first molars, upper and lower, were in place, and their crowns were little worn. The lower jaw was actually in place, with only the rear lower part missing. Furthermore, the skull showed on one side most of the cast of the brain.

Within a few weeks, Dr. Dart had written his preliminary report on this find, in which he made the exciting statement that this skull was from "an extinct race of apes intermediate between anthropoids and man." He had secured the nearest thing to the popular conception of a "missing link." "Unlike *Pithecanthropus,*" he stated, "it does not represent an ape-like man, a caricature of precocious hominid failure, but a creature well advanced beyond modern anthropoids in just those characters . . . which are to be anticipated in an extinct link between man and his simian ancestor."

As soon as the discovery had been announced, Dr. Robert Broom went to Johannesburg to see it. Dr. Broom, then in his fifty-eighth year,

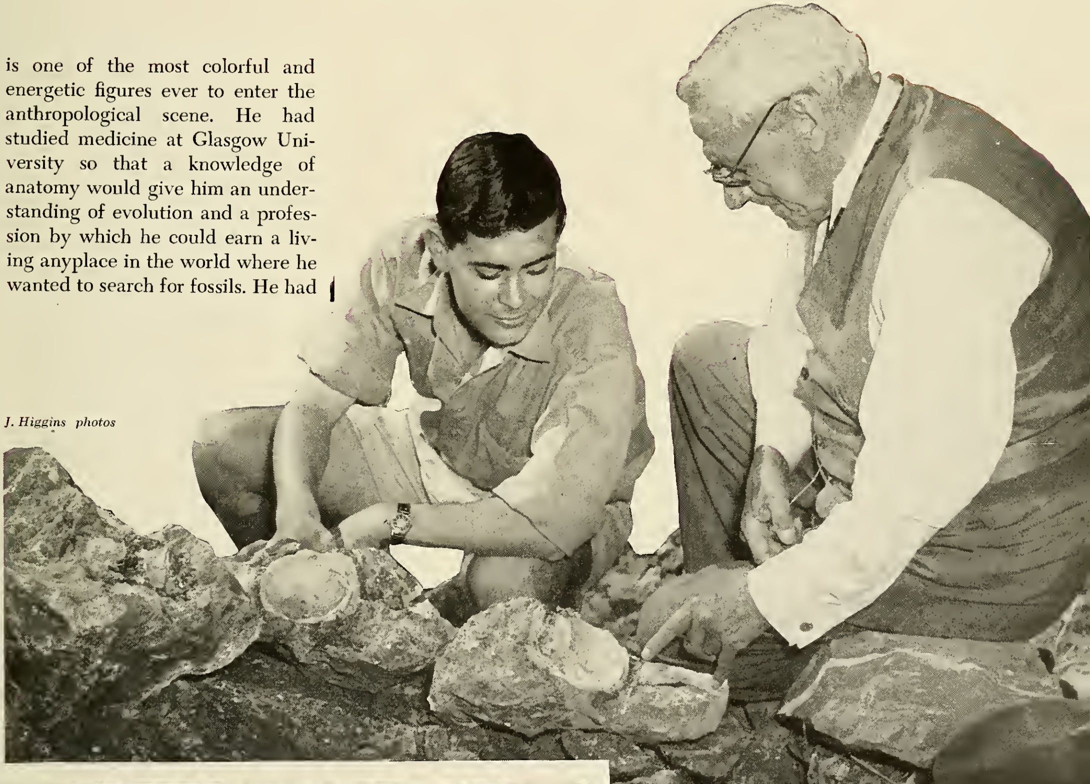
ssing Links" from Africa

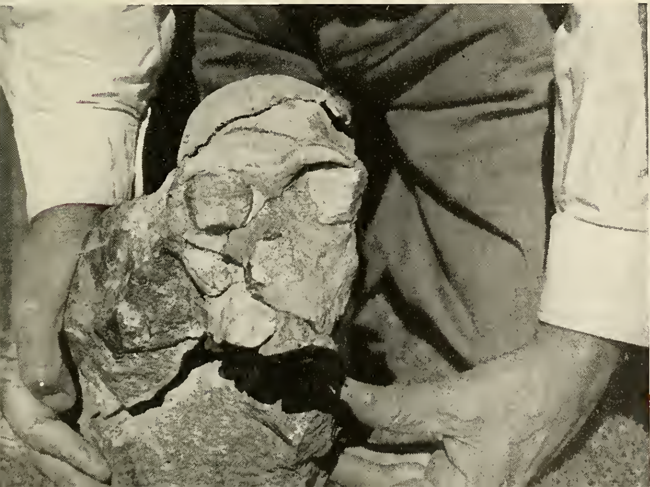
natic discoveries clarifying man's earliest ancestry have come from the Transvaal

By Dan Lincoln Thrapp

is one of the most colorful and energetic figures ever to enter the anthropological scene. He had studied medicine at Glasgow University so that a knowledge of anatomy would give him an understanding of evolution and a profession by which he could earn a living anyplace in the world where he wanted to search for fossils. He had

J. Higgins photos





▲ The Sterkfontein Skull found by Dr. Robert Broom in April, 1947, was nearly perfect. The skull was broken across the brain cavity and was lined with a layer of lime crystals

◄ The Face. Here most of the stone has been removed and the pieces of the face have been temporarily put together to show the facial contours of the Sterkfontein Skull carried through his plan, and a quarter of a century of determination, diligence, and deduction, with the help of a little dynamite, had brought him wide recognition in the science of paleontology.

Dr. Broom stoutly supported Dr. Dart's conclusions as to the profound significance of this skull. It represented, he was convinced, a creature far from an ape and very close to the main stem of the human family tree.

Even though this skull conformed perfectly to the expectations of Darwin, Huxley, Haeckel, and their numerous successors, some scientists were slow to accept Dart's conclusions. The eminent physical anthropologist Aleš Hrdlička was on the fence. However, Dart's and Broom's conclusions were sooner or later welcomed by Prof. G. Elliot Smith and Prof. W. J. Sollas of Oxford, and by Drs. James H. McGregor and William K. Gregory of Columbia University and the American Museum.

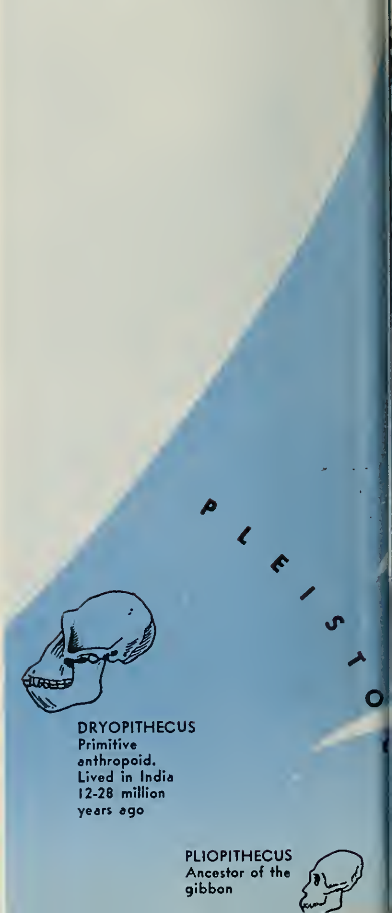
Shortly after the discovery was announced, four of the leading anthropologists of Britain were asked by the British scientific publication *Nature* to express their views. They were Sir Arthur Keith, Prof. G. Elliot Smith, Sir Arthur Smith Woodward, and Dr. W. L. H. Duckworth, all world renowned.

Australopithecus africanus, as Dr. Dart named the skull, portrayed to Keith a blend of immature chimpanzee and gorilla characteristics, but he added, "Even if it be admitted that *Australopithecus* is an anthropoid ape, it is a very remarkable one. It is a true long-headed anthropoid—the first so far known."

Elliot Smith thought Dart was "justified in creating a new species or even a new genus for his interesting fossil," but he thought that "many of the features cited by Prof. Dart as evidence of human affinities . . . are not unknown in the young of the giant anthropoids." Smith Woodward said, "So far as can be judged from the photograph I see nothing . . . definitely nearer to the human condition than the corresponding parts of the skull of a modern young chimpanzee." Duckworth admitted that the specimen "possesses exceptional interest and importance." He thought that some of the supposed manlike characteristics were due to "the youthfulness of the specimen," but added that "if the good points can be justified, then these characters of youth will not gravely affect the final decision." On the basis of evidence then at hand, these statements do not even now sound unreasonable for the most part.

But Drs. Broom and Dart set about together to change the views of the faraway scientific authorities whose word, they felt, might have a crucial effect on world-wide opinion. Dr. Broom sent a section of the Taungs skull to Oxford's Prof. W. J. Sollas, who was on record as agreeing with Elliot Smith. Sollas immediately replied that the section "seems to me to throw quite another light on the matter." He said he had just written to *Nature* to show how widely Taungs differed from a chimpanzee skull. And he was preparing another paper to show how nearly it resembled man.

Elliot Smith soon came to agree with Sollas. American anthropologist Dr. Aleš Hrdlička agreed that *Australopithecus* was a "missing link" but qualified this by saying that it was one of many still "missing links in the realm of primate ancestry." Later, Dr. W. K. Gregory of the American Museum studied the teeth and found 20 characteristics in which they resembled or were transitional to man, none in which they clearly resembled the chimpanzee, and only three in which they were nearer to the gorilla or to the gorilla and chimpanzee. Other anthropologists gradually became convinced, and after the Sterkfontein and Kromdraai finds, which will be discussed later, even Sir Arthur Keith conceded, in 1944, that "no doubt they are much more human than I had originally supposed." Oxford University's famed anatomist Prof. W. E. Le Gros Clark has quite recently swung his full weight behind Dr. Broom in the conviction that the Australopithecinae, the sub-family of extinct forms defined by William K.

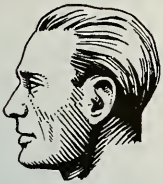


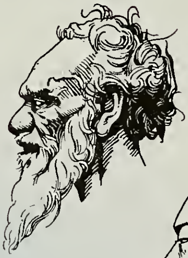
Among all living animals, the anthropoid apes, especially the gorilla and chimpanzee, come the nearest to man. The similarity is seen not only in their bones and internal organs but in the mode of reproduction and in the course of development within the body. The anthropoid apes are also the only animals that show the beginnings of human intelligence.

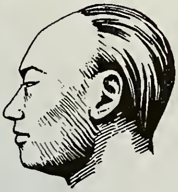
The three "missing links" from South Africa (*Australopithecus*, *Plesianthropus*, and *Paranthropus)* were much more like human beings than the modern apes in certain respects. On this chart, prepared from an exhibit in The American Museum, they fork off from the main stem and are not ancestral to any existing creatures. In this sense they might be called man's great uncles. Drs. Broom and Dart, on the other hand, have argued that these three "missing links" belong on the main evolutionary line and are our distant grandparents.

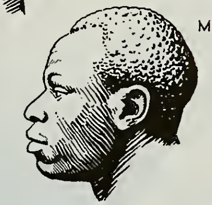
PLEISTO
DRYOPITHECUS
Primitive anthropoid. Lived in India 12-28 million years ago
PLIOPITHECUS
Ancestor of the gibbon

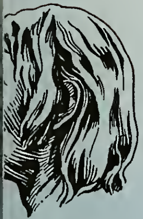
FAMILY TREE OF MAN

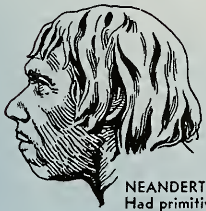

MODERN WHITE


MODERN AUSTRALIAN

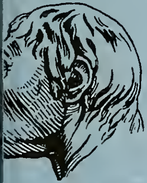

MODERN CHINESE

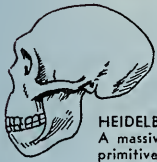

MODERN NEGRO

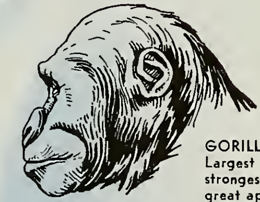

RO-MAGNON
ntelligent, artistic, and
odern-looking European
ace of 40,000 years ago.

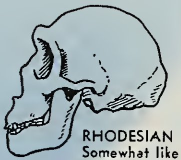

NEANDERTHAL
Had primitive profile; made many tools. Lived for 100,000 years or more before Cro-Magnon

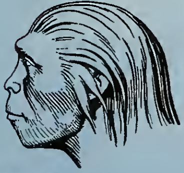
RECENT

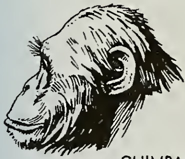

IECANTHROPUS
a Ape Man)
t, but apelike.
d over 500,000
s ago.

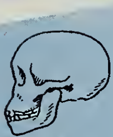

HEIDELBERG MAN
A massive jaw, teeth primitively human. Lived in second interglacial stage of Ice Age.

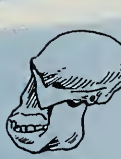

GORILLA
Largest and strongest of the great apes—Equatorial Africa

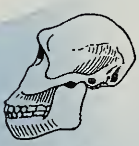

RHODESIAN MAN
Somewhat like Neanderthal but more brutish, with massive eyebrow ridges

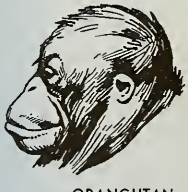

PEKING MAN
A very primitive type but more advanced than Pithecanthropus. Made fire, used tools, probably spoke

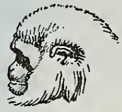

CHIMPANZEE
Smaller and less ferocious than gorilla


AUSTRALOPITHECUS
A 100-pound creature that stood upright, hunted in groups, and had milk teeth like a Bushman child


PLESIANTHROPUS
Most manlike of the missing links from South Africa


PARANTHROPUS
Had larger brain than other two and a tremendously powerful jaw


ORANGUTAN
Anthropoid ape of Borneo


GIBBON
Smallest of the anthropoid apes

Gregory and Milo Hellman in 1938, were very close to the main stream of human evolution.

The discovery of the Taungs Skull caused Dr. Broom to redouble his diligence as a fossil hunter, and he worked tirelessly to find additional evidence to support and amplify the original claims. But it was not until twelve years later that his devotion was rewarded. On August 17, 1936, at Sterkfontein, near Krügersdorp, a lime quarry foreman, G. W. Barlow, handed him the blasted-out natural brain cast of a missing link and asked, "Is this what you're after?" Dr. Broom replied, "That's what I'm after."

He at once began a meticulous search of the cave from which the brain cast had come. The next day he found additional pieces of the same specimen, and in a few years he had discovered parts of three other skulls, all probably of the same species. This type was different from the Taungs creature but evidently related to it. Dr. Broom continued his search for new types, and within two years he made another sensational find.

Barlow one day handed him a piece of a palate that he had gotten from a fifteen-year-old schoolboy, Gert Terblanche. The boy had found it at Kromdraai, two miles east of Sterkfontein.

"Of course I immediately set out in pursuit of Gert," wrote Dr. Broom. "I went to his home. Gert was in school, another two miles away; but I saw his mother and sister, and his sister took me up to the top of an adjacent hill where the specimen had been broken out of a weathered outcrop of bone breccia. The sister told me that Gert had four beautiful teeth with him at school, and she was sure he had some other nice pieces hidden away somewhere.

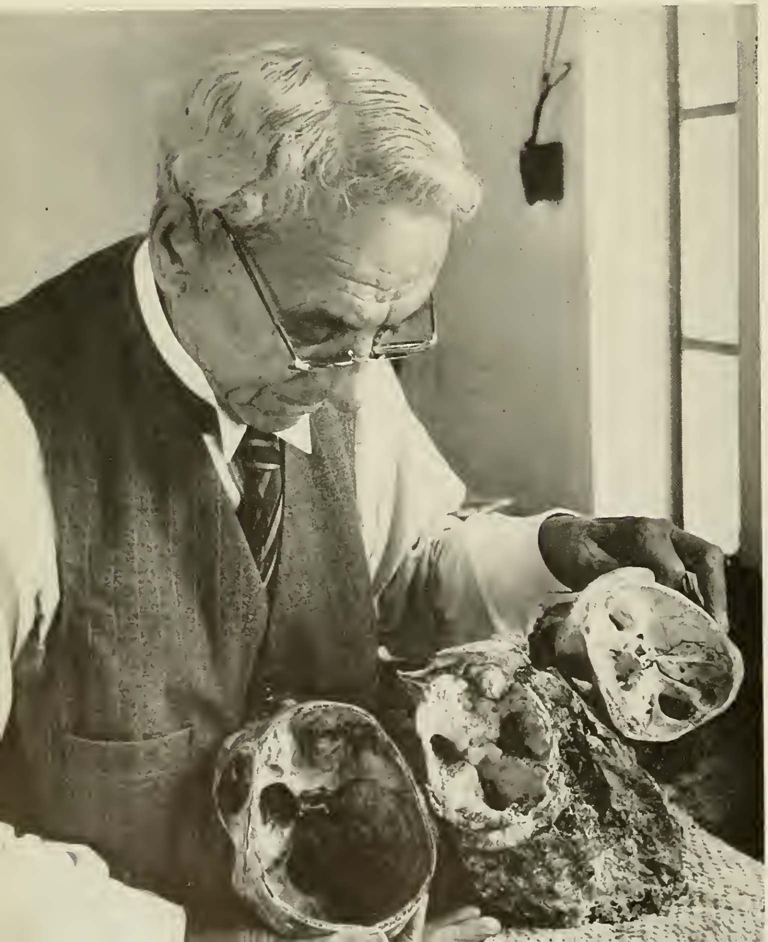
"I went off to the school. It was playtime, about 12:30 P.M., when I arrived. I saw the principal and told him what I had come about. Gert was found, and he drew from his trousers pocket four of the most wonderful teeth ever seen in the world's history. Two of these fitted on the palate that I had in my pocket. The other two were teeth of the other side.

"Gert told me that there were some more bits hidden away on the hillside. As the school broke up at 2 o'clock, I suggested to the principal that I would give a lecture to the teachers and the children on how the caves were formed and how animal bones got into them. He was delighted. So I lectured to 4 teachers and about 120 children for over an hour. As it was now almost 2 o'clock, the principal dismissed the classes, and Gert came away with me and took me to the place on the hill where he had carefully hidden away a nice lower jaw. I gathered every fragment." The newest find was different from either the Sterkfontein or the Taungs remains.

Dr. Broom now had three distinct types of apemen, or man-apes —the argument over which they are to be called has not yet ended.

Each of the three new finds, Dr. Broom believed, represented a different genus. The Taungs skull had been named *Australopithecus africanus* Dart. The Sterkfontein creature became *Plesianthropus transvaalensis* (Broom). And the Kromdraai specimen, which had been found by Gert Terblanche, was named *Paranthropus robustus*

J. J. Wesselo photo. Copyright.



◄ **Dr. Broom** comparing the Sterkfontein brain case with the human (*left*) and the chimpanzee (*right*). Though it is much smaller, he considers it more closely related to the human

Broom, the "*robustus*" referring to its tremendously powerful jaw.

Dr. Broom resumed digging at Sterkfontein after the war and within a few months found parts of several other skulls. He also found the greater part of a pelvis that was almost human and many limb bones of his strange and important little creatures. In all, he probably has pieces from a dozen or more different individuals, and some of the skulls are nearly complete and quite uncrushed. From them, and from the ribs and limb bones, he could tell quite a bit about what sort of animals they represented. Of the three, *Plesianthropus* seemed the most manlike, although *Paranthropus* had the largest brain. His *Paranthropus crassidens* jaw, found quite recently in a new site (Swart Krans) has an incipient chin, and its general appearance is "almost human." Thus, some of the later Australopithecinae may have crossed the invisible and arbitrary border between apes and men.

The face bones of *Plesianthropus*, in certain details approach the human, and the limb bones were so manlike that at first there was some suspicion that modern bones might have been intermixed with the fossils. This was promptly proved impossible. Entire limb bones are as yet extremely rare, but Prof. Straus of Johns Hopkins has made prolonged studies of the distal end of the humerus ascribed to *Paranthropus robustus* and has stated that it falls within the ranges of both apes and men. Therefore, its exact status is indeterminate. Prof. Straus has recently examined the distal end of a thighbone and states that it is "wholly unlike the great apes." On the other hand, Dr. Broom has shown that the talus (anklebone) is close to the Bushman's, though the rounded bearing surface on the lower end is wider.

Most outstanding to a scientist were the teeth, but here again the question can be raised, "Where do apes stop and men begin?" The boundary line is, of course, arbitrarily set by man, not by nature. The canine tooth was not long and fanglike, as it is in modern anthropoids, especially in the males. The teeth were arranged in a palatal arch almost like that in a human skull, and from the wear on the grinding surfaces it was clear that their owners had chewed like human beings. The milk teeth of *Australopithecus* were almost identical with the milk teeth of a Bushman child, Dr. Broom found, and in some important characters very different from those of apes.

Also, the milk teeth referred by him to *Paranthropus robustus* were amazingly similar to a Bushman's. Could they by any chance *be* those of ancient Bushmen? Here the geologists Charles L. Camp and George B. Barbour agree with Dr. Broom that no modern Bushman could possibly have become fossilized in association with Broom's specimens.

Even a cursory examination showed that these fossils, like the Taungs Skull, were going to be of more than ordinary interest to science. In 1929, Dr. Dart had written of the original discovery: "The geographical position of the Taungs deposit showed for this anthropoid an environment which up to that time had been regarded as impossible for an ape. We never knew before of an ape which lived on a cliff or plateau overlooking broad, forestless plains, on the fringe of a desert . . . Geography showed us that it was an impossible kind of ape — a terrestrial, fleet-footed, or cursorial ape. It was an animal-hunting, flesh-eating, skull-cracking and bone-breaking ape. It was a cave dweller. It was the most generalized of all apes."

These creatures stood upright like man, but they only weighed 100 pounds or so. Their brains, though very small by human standards, were much larger in proportion to their bodies than in any modern ape. In fact, the ratio of brain to body approached that of man. They lived in groups, hunted in packs, crushed the skulls of captured baboons with the leg bones of antelopes, and may have had some sort of speech.

The question of how long ago these animals lived has evoked much lively debate. Ordinarily, beds of rock can best be dated by the species of animals found in association with them. But in South Africa, the fossil animals found in association with *Plesianthropus* and *Paranthropus* are local types that have no close relatives among the animals of Europe and Asia, where the standard geologic column has been worked out.

The animal remains are fairly abundant, however, and future researches will help greatly to clear up this question. Most of the animals were desert or open-plains types. With *Plesianthropus* were found a saber-toothed tiger, golden moles, two types of baboons, antelopes, and hyenas, and in a near-by cave were found some horse teeth. With the Taungs specimen were found small extinct baboons, their skulls crushed neatly as though with particular antelope leg bones, which, in fact, sometimes fit the dents. Other creatures from the Taungs caves include a hyrax, a mole, a shrew, two types of antelopes, a rock rat, and several ordinary rats. Gert Terblanche's *Paranthropus* skull from Kromdraai presented greater difficulties, because it was weathered out from an outcropping that showed few other bones, although there was some fine breccia not far distant that may have been contemporaneous. In it are horses, baboons, saber-toothed cats, pigs, foxes, hyenas, and jackals.

The animals found in the three deposits would seem to belong in the Lower Pleistocene period, which began about a million years ago, or in the Upper Pliocene, which preceded it. Dr. Broom thinks that all may be safely assumed to be over 750,000 years old and that many may be well over 1,000,000 years old—probably 1,500,000 years, perhaps even more. Thus he believes that a few belong in the Lower Pleistocene but that most are from the Upper Pliocene. Support for this latter theory might appear to lie in a special type of hyena known only from the Pliocene and found in the Sterkfontein caves

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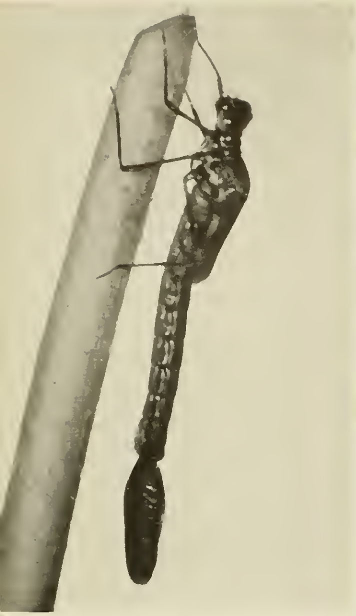
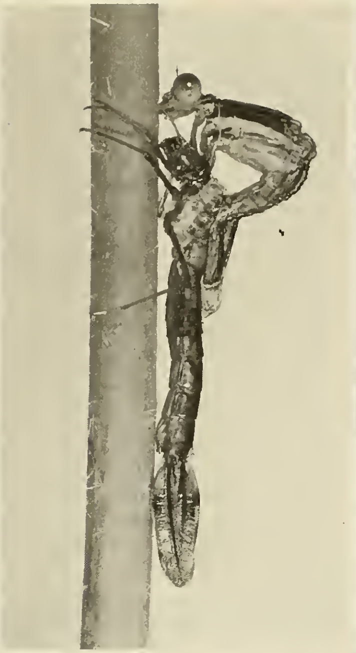
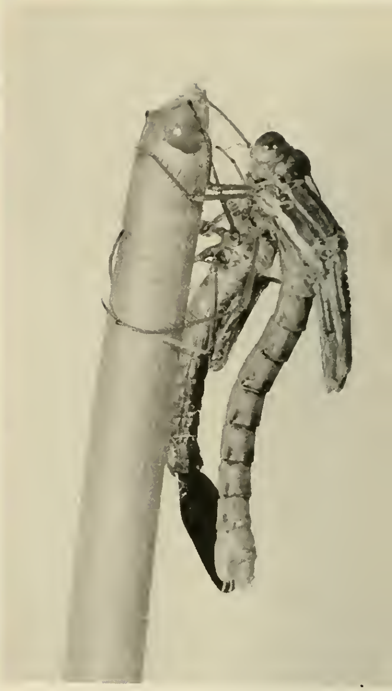


▲ WHEN ITS TIME IS RIPE, the bulbous-eyed nymph climbs a plant stem to a position a little above the water surface. Note its curious leaflike tail appendages, which look like the tail fins of some fish but are, in reality, the water-breathing gills



▲ ANCHORING the tarsal claws securely, a slow pumping action soon produces a dorsal rupture just forward of the wing pads, and a hump of the new animal appears



▲ THE FOLDED AND CRUMPLED WINGS are soon seen, prophetic of the creature's coming mastery of the air

Debut of a Damsel Fly

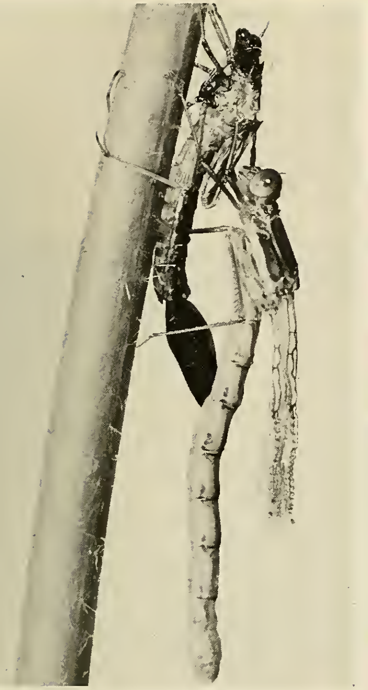
A fairy of the upper air, which "down the listed sunbeam rides resplendent"

By WALKER VAN RIPER
Denver Museum of Natural History

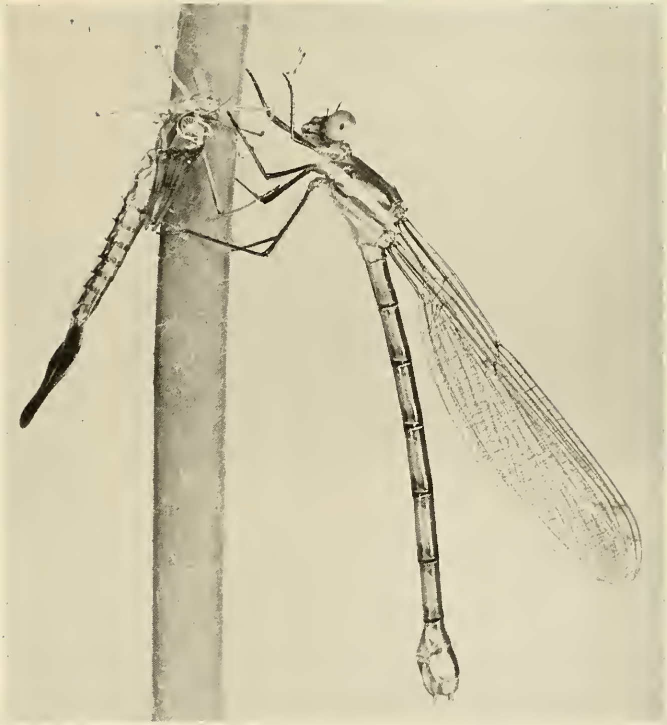
All photographs by the author

THE spectacle of the transformation from nymph to damsel fly is common enough in nature, yet it is not often seen. The voracious nymph lives in stagnant ponds and has curious forward-shooting, grappling tongs with which to capture its prey. This unattractive creature becomes a beautiful, mosquito-eating damsel fly of the upper air. It completely changes its form and mode of life during the period of an hour or more. This is a time of great risk and danger, for the insect is entirely helpless, incapable of flight or other movement and an easy prey to its chief enemies—birds and frogs. For the most part, the risk is avoidable if the insect undergoes its transformation before the break of day, and such has become its general habit. This is the reason, of course, why the process is rarely observed.

The accompanying pictures were taken with a high-speed electric flash, the exposures being about 1/5000 of a second at aperture f.32. The subject is a stalk-winged damsel fly of the family Coenagrionidae.

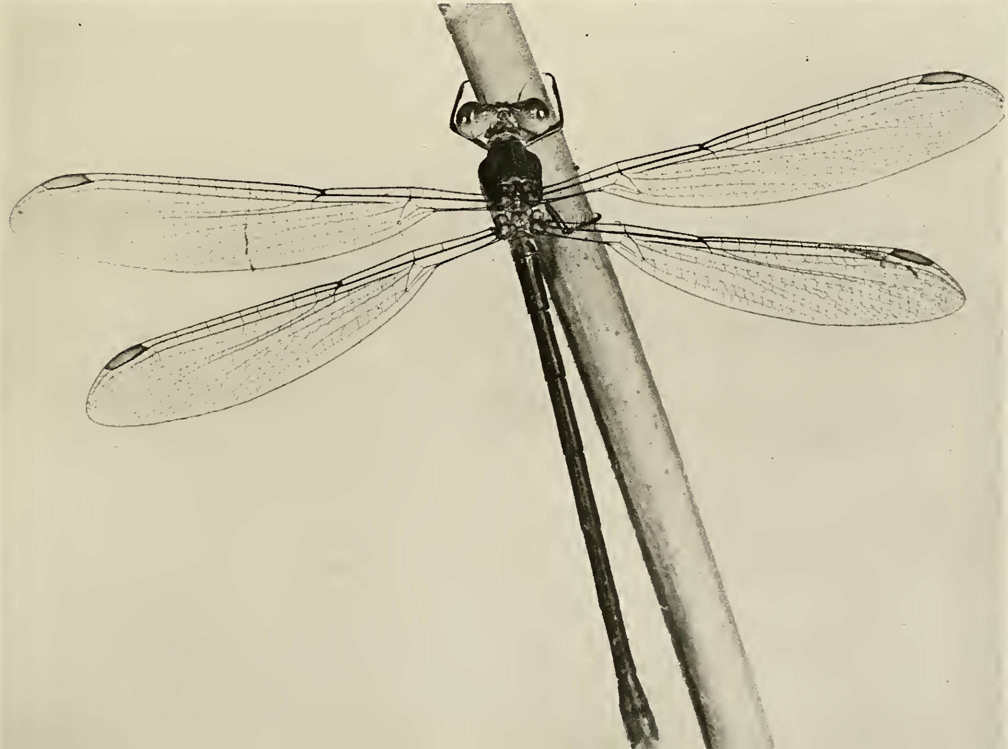


▲ Slowly the wings unfold, and the abdomen lengthens considerably



▲ The wings flutter, delicate and gauzelike . . .

▼ . . . and out of its ugly shroud, a diaphanous new damsel fly is ready to become air-borne



▲ A BASUTO ELDER looks out over his country

▼ A BASUTO HERD BOY: a common Basutoland scene. Schoolteachers have a hard time teaching these youngsters, for their attendance is erratic. A Basuto has little use for money in the bank and measures wealth in terms of cattle and sheep. This has led to soil erosion from serious overstocking. Most young men pay for their brides in cattle

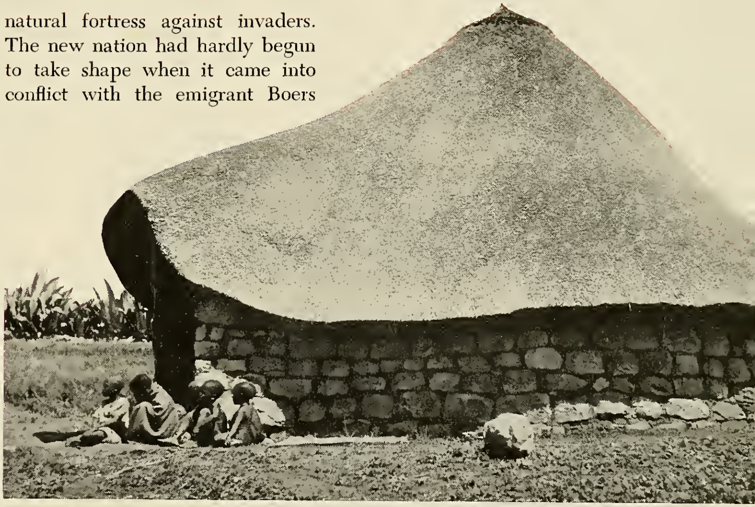
Basutoland

By Constance Stuart

Welded together almost a century and a half ago under the genius of their great leader Moshesh, the Basutos seek to retain their cultural identity and their right of self-determination under the awakening influence of modern education

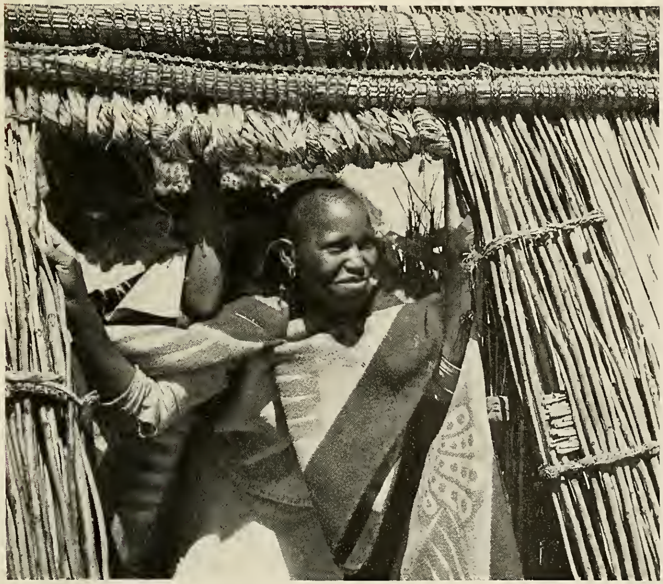
FROM about 1820 onward, Moshesh, a young chieftain of insignificant stock, succeeded by his diplomatic skill in gathering together the remnants of tribes that had been scattered by the raids of the Zulus and the Matabele. He settled with them in the mountains of Basutoland, which formed a natural fortress against invaders. The new nation had hardly begun to take shape when it came into conflict with the emigrant Boers of the Great Trek, commonly called the Voortrekkers, the result being that the Basutos lost part of their territory. Moshesh thereupon appealed for and was granted British protection, under which a series of Paramount Chiefs have ruled ever since. The Basutos thrived as a nation and now have the largest population of the three protectorates that come under the British government's "indirect rule" —Basutoland, Swaziland, and Bechuanaland.

During World War II, 20,000 Basutos formed part of the African Pioneer Corps and served in the Mediterranean area. In 1947, the nation staged a great *Pitso* (meeting) of welcome for the Royal Family at Basutoland's capital,



➤ A BASUTO HUT. Nowadays the walls are often made of stone, because there is very little timber

➤ SOME OF THE HUTS have a fence of reeds around them for privacy. The reed curtain rolled up above this doorway can be lowered

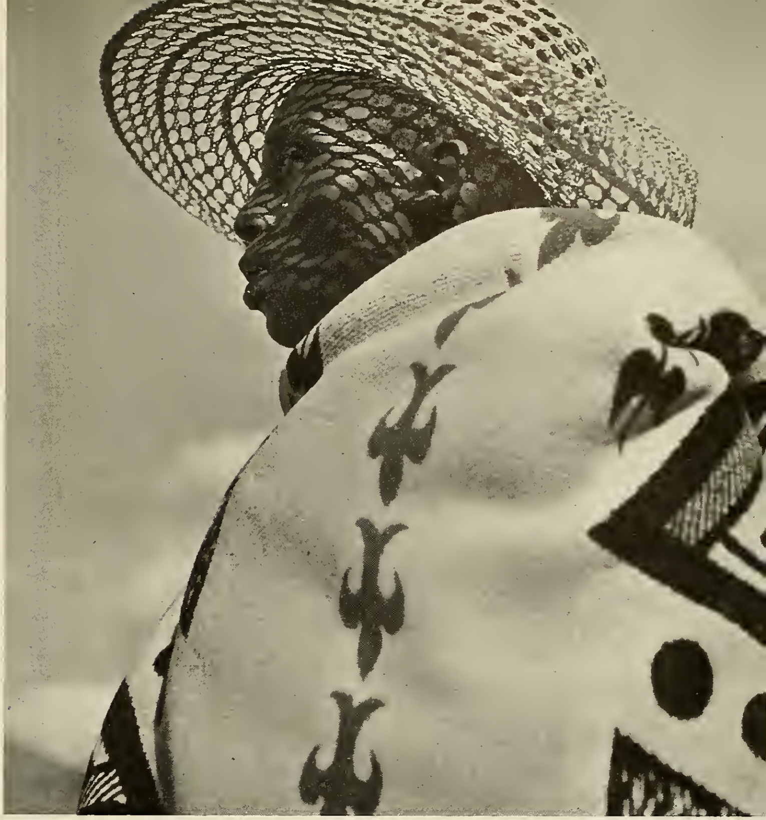


➤ THIS HERD BOY wears his weather-beaten straw hat at a rakish angle. His young brother smiles shyly in the background like a little French gargoyle. Herd boys as young as five are not an uncommon sight

▼ AT THE PARAMOUNT CHIEF'S KRAAL, or village. On the left is one of the "courts," where the head tribesmen meet daily to listen to cases of cattle theft, domestic troubles, etc.

Maseru. Thousands of Basutos rode for days from far up in the mountains and from the plains to be present at the greatest gathering of their people in many years. The small capital was filled with these colorful horsemen.

Basutoland has an area of 11,000 square miles—comparable to the state of Maryland—and a population of over 600,000. It is a native territory without European settlers or landowners and is governed by a system of "indirect rule." The Basutos swear their allegiance to a single Paramount Chief, under whom there are many lesser chiefs. Many of these chiefs



▲ SUMMER AND WINTER the Basuto wears his characteristic blanket of gay and varied design and color. Before the days of traders, skin clothing and (in cold weather) a simple undecorated cloak sufficed. Today the Basuto buys his blankets at European-run trading stores, which are scattered through the territory. The hat is woven of grass by the Basutos themselves

HE TRADING STORES are a center of contact with the outside world.
the Basuto buys blankets, shirts, European hats to wear on
ays, and yard goods. The more ambitious may even buy shoes,
h will hurt the native's feet, for he is unaccustomed to such con-
nent. He can walk hundreds of miles in his bare feet

▼ THE MEN RETURN from the mines for six months at a stretch to enjoy the pleasures of family life and to look after their domestic concerns. Most Basutos own a little land where they grow corn and graze their stock

▼ BASUTOS COMING HOME from their stretch of work in the gold mines, 600 miles away in Johannesburg. The bus stops to allow them to buy potatoes and oranges from a roadside vendor

MA ETENG TO MAS
PHAMOLA
TAXI

▲ A Basuto mother and child

are related to the great Moshesh and are collectively known as his "sons."

The visitor finds this one of the most picturesque of native territories, with its ranges of mountains, its men clad in colorful blankets and riding Basuto ponies, and its well-built thatched villages, grouped at the foot of the mountains.

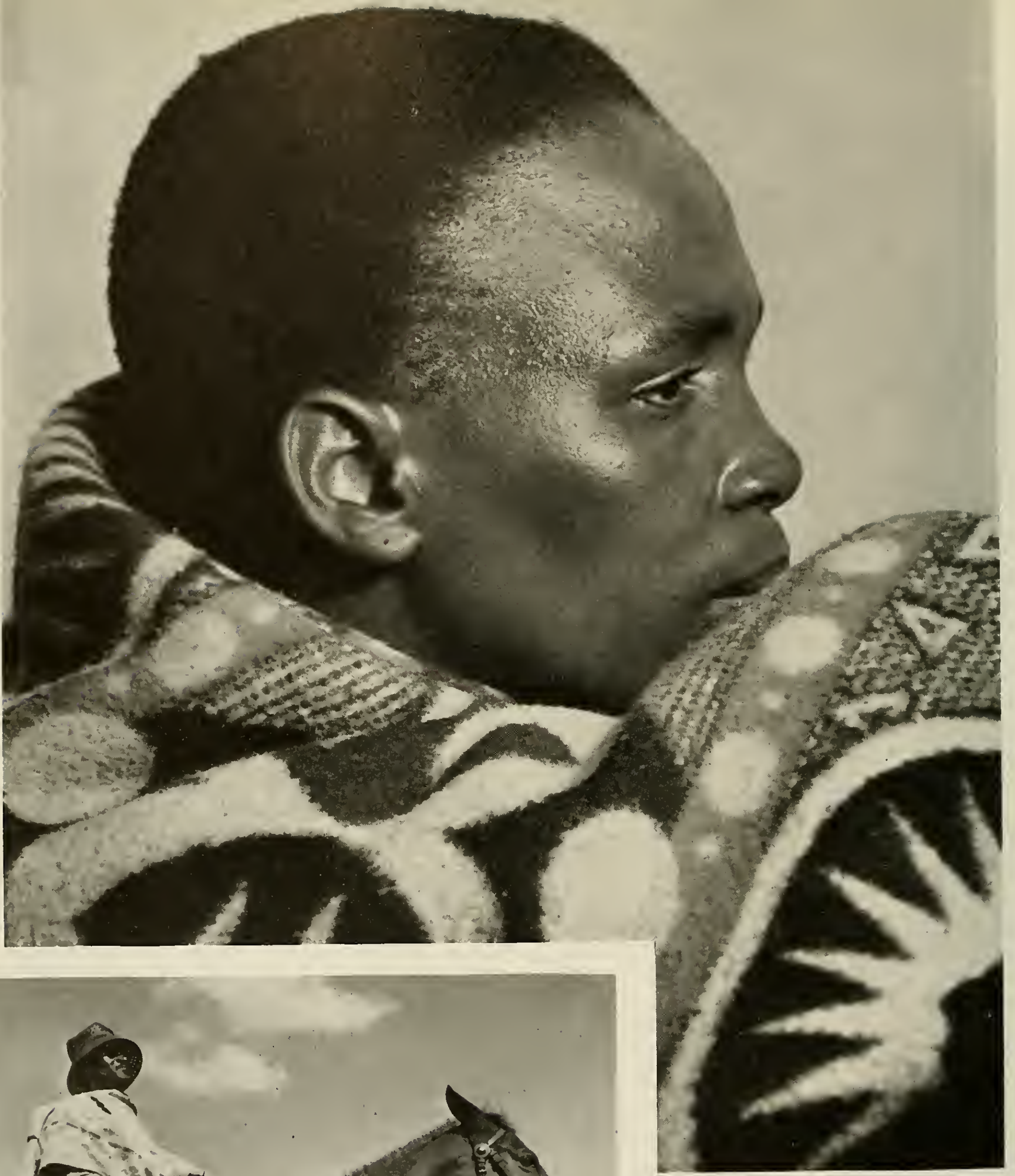
Education is considerably affected by the mountainous nature of the country. There is a tendency to concentrate the schools in the lowlands, which comprise only one-third of the country, to the detriment of the remaining two-thirds. In spite of this, a strong feeling for education exists among the Basutos, and this is doing much to combat the traditional witchcraft and superstition. But "ritual" murders and pagan initiation ceremonies are still practiced in villages less than a day's ride on horseback from the capital.

Basutoland subsists on its agriculture. In the lowlands, the main crops are maize and kaffir corn, which is grown during the Southern Hemisphere's summer. The heights above 8000 feet are termed "cattle post" areas and are used for

◂ Having a bath in the European fashion, rather than in the river

▴ After the bath is over

◂ Catholic influence from the mission stations scattered through Basutoland is evident in this Basuto's rosary. Best known of the missions has its own press, where many publications are printed in Se Suto, the language of the Basuto. Basuto witch doctors nevertheless have a powerful influence even over Christian members of the community. Many natives will not use European-trained doctors but prefer to take the witch doctor's brew, which probably contains much that is harmful, such as bits of decayed animals

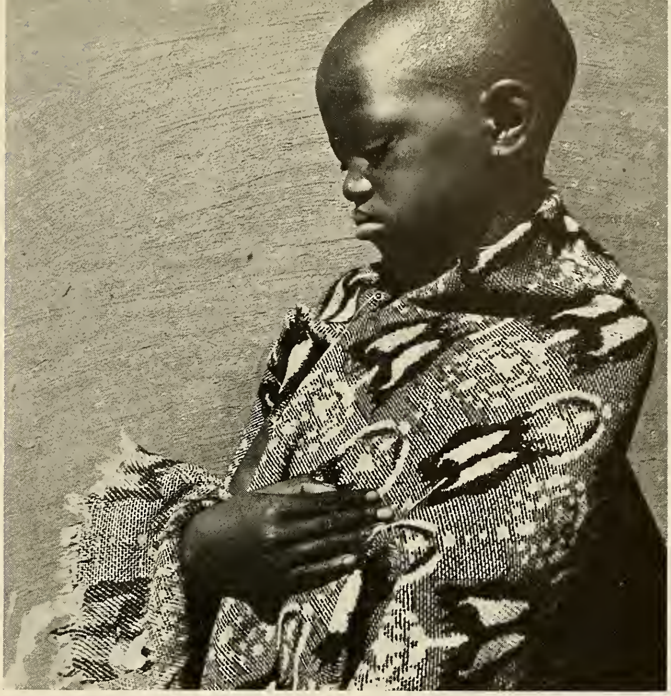


▲ BASUTO WOMAN. Hair longer than this is seldom seen

◀ HORSEMAN OF BASUTOLAND. The "Basuto pony," a breed developed locally, is famous throughout South Africa for its hardiness and sure-footedness on mountain trails grazing, livestock being moved to them from the lowlands for the summer and back again for the winter months.

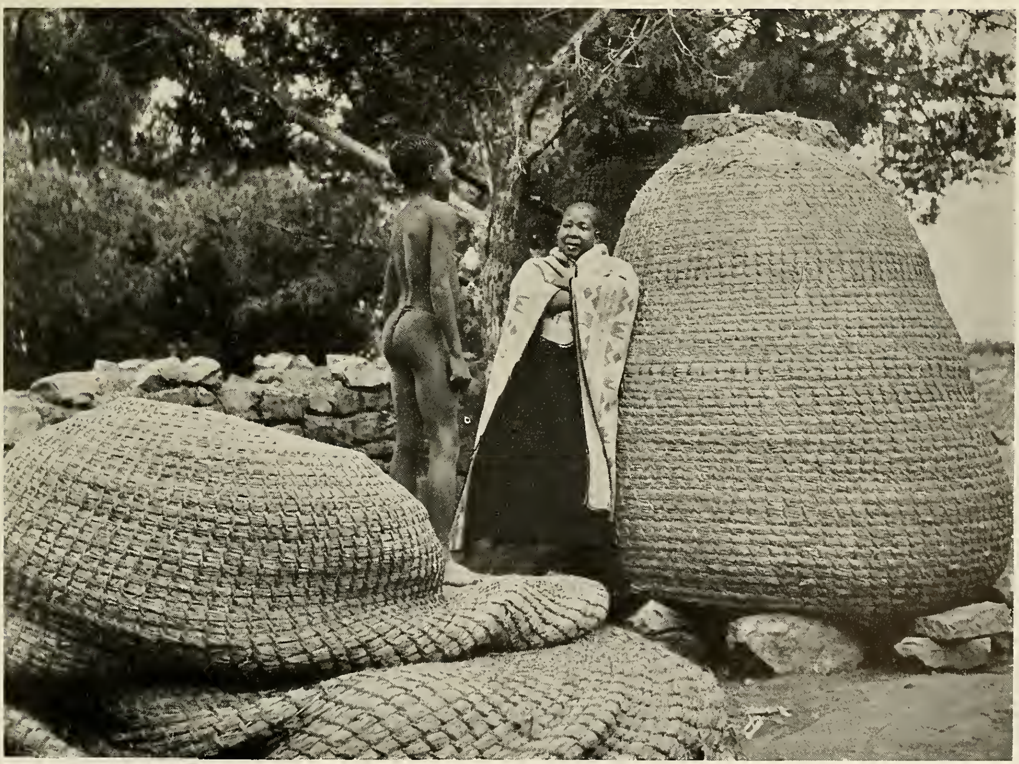
The chief exports to the Union of South Africa are wool, wheat, and cattle. The arable land is insufficient to maintain the population, and many thousands of Basutos are recruited yearly to the mines, to industrial centers, and to farms, from which they send back their contributions to the national wealth.

There are few roads on which cars can travel in Basutoland, but there is a network of bridle paths up into the mountains. Thus one can reach any village or any part of the country by horse or by sturdy Basuto pony. The only railway in the country is a track one mile long, which connects Maseru with the Union of South Africa.



▲ A LITTLE BASUTO GIRL, who even though young, displays the natural dignity of her people

▼ THE BASUTOS WEAVE these immense baskets to hold their corn in winter. Talking to the youngster is a daughter of the Paramount Chieftainess



A "Little Yellowstone" that operates—of all places—in the dry-as-dust Nevada desert

NEVADA'S
VALLEY OF GEYSERS

By NELL MURBARGER

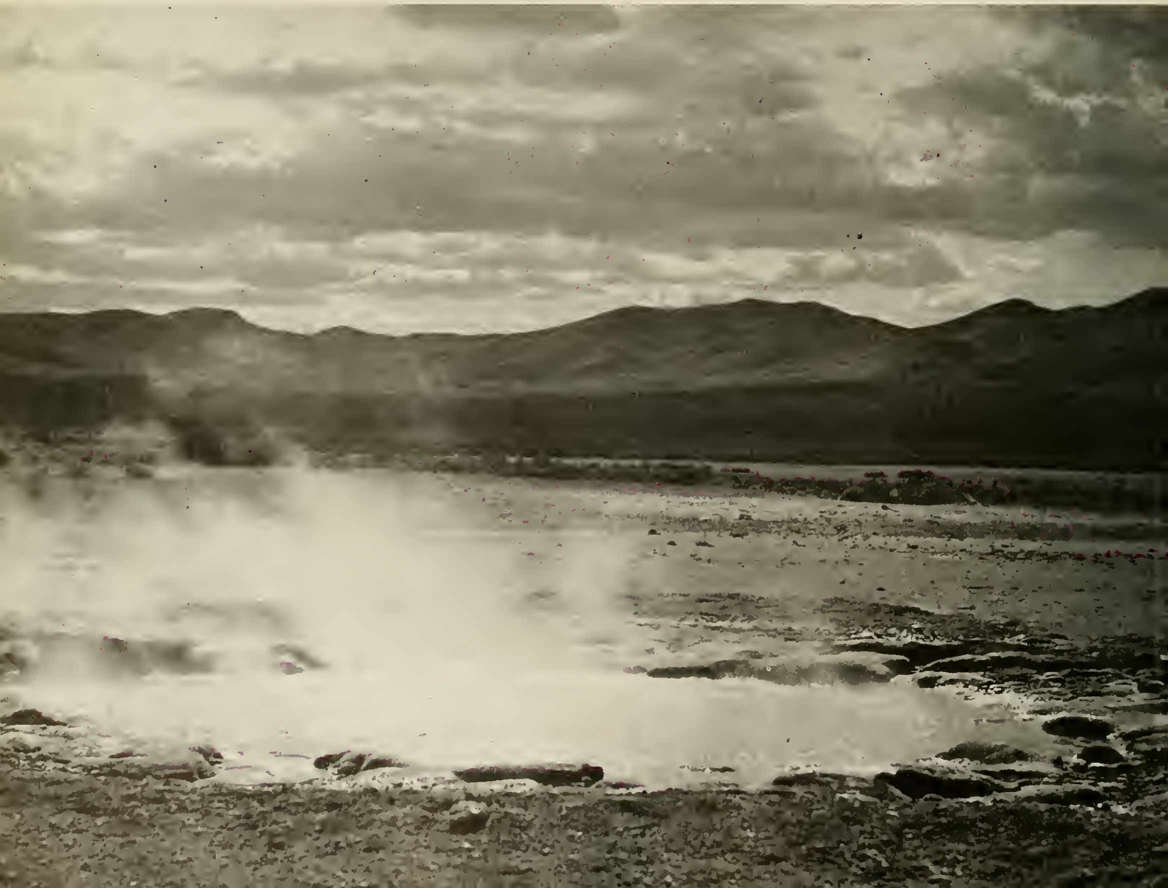
Photographs by the author

IT was an old Nevada miner who first told me of Whirlwind Valley. He described it as a place where scalding steam jetted from fissures in an opal terrace, where crystal pools pulsed with boiling water, where mud pots blubbered, and ominous rumblings issued from subterranean grottoes. This was fascinating campfire talk, and I put it down for just that. I had camped and explored in every county and mountain range in Nevada, and if such a place existed, it seemed impossible that I shouldn't have heard of it.

Several months later, B. F. Couch, Librarian of the Mackay School of Mines, at Reno, assured me that the miner's tale was more than idle talk, that there was such a field of thermal activity about seven miles southwest of Beowawe, in Eureka County. So little was it known, he said, that my ignorance of it was altogether understandable.

Originally discovered by white men about 1867, Whirlwind Valley had been first described in a feature article by Albert S. Evans, published in 1869 in the *Overland Monthly* of San Francisco. More than two generations seem to have

▼ DESERT CONTRADICTION: steam rising from a hot pool in the barren flats of Whirlwind Valley. This is the largest of the five springs in the valley floor



elapsed before a second report was issued—a technical treatise in the *American Journal of Science* for March, 1934. It was prepared by T. B. Nolan and G. B. Anderson of the United States Geological Survey following "a few hours" spent in the study of the area in August, 1932.

"So far as we can find, nothing further has been published on the district," Mr. Couch said.

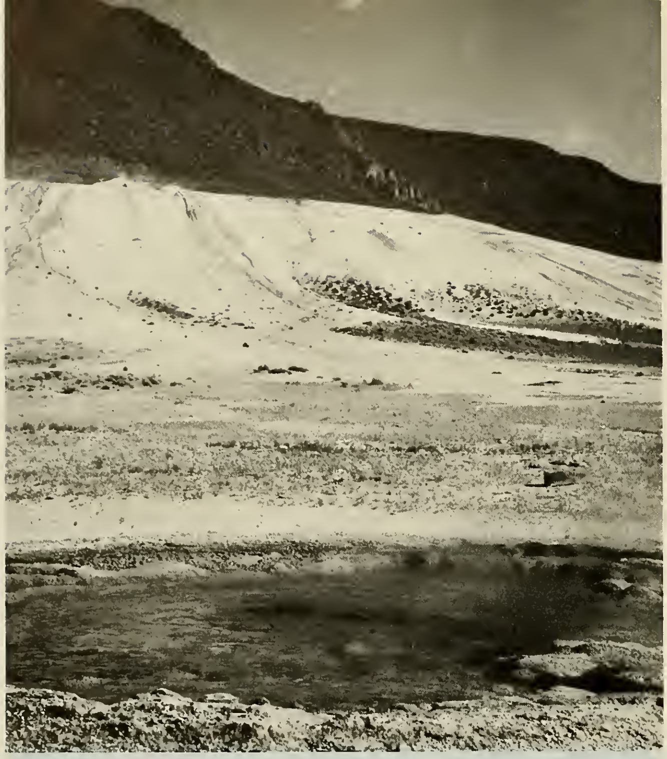
From the Nolan-Anderson, report, I gathered that the Whirlwind Valley geyser field was not exactly a second Yellowstone. Yet the idea of boiling water gushing from central Nevada's dry-as-dust desert ranges was, in itself, a prospect sufficiently alluring to draw me to the place at the first opportunity.

After provisioning in the small desert village of Beowawe, my companion—Dora Tucker—and I headed out across a broad, white alkaline flat. In giving us directions for finding the geysers, the storekeeper at Beowawe had said that for five miles our road would consist of nothing but the bosom of this flat and that in crossing it we must maintain a sharp watch to avoid wet areas.

"Not that there's any actual water on the flat," he said, "but there's underground seepage. Occasionally you'll come to areas where the powdery white surface of the ground appears slightly darker. That means it's wet just beneath the crust—not only wet but practically bottomless! If you're careful to stay clear of these boggy areas, I think you can make it—un-

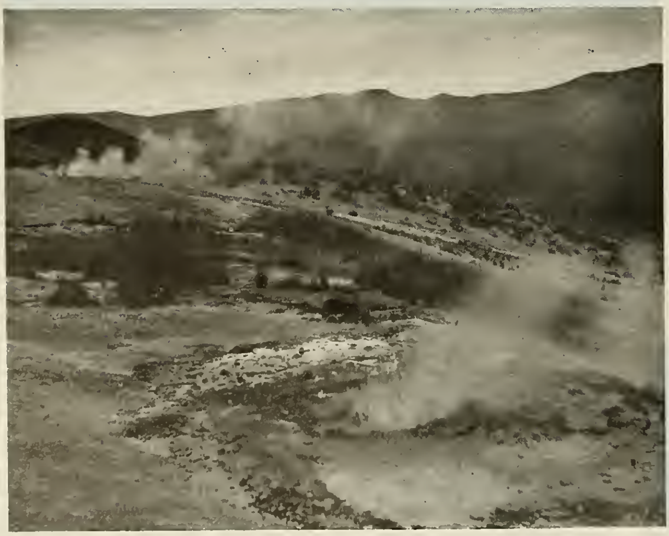
▲ **Erupting** at irregular intervals, the largest geyser on the terrace shoots hot water and steam to a height of 25 or 30 feet

◀ **Several small geysers,** such as this one, erupt to a height of two or three feet



▲ The color-streaked sinter terrace (*middleground*) is the area of greatest thermal activity. It includes low-spouting geysers, hot bubbling springs, blubbering mud pots, and subterranean caves

▼ Steam spirals from the vents and hot-water pools at the lower end of the sinter terrace. The roarings and rumblings of the disturbed waters produce an unearthly effect



less you get caught in a rain!" Critically appraising a handful of clouds on the eastern horizon, the storekeeper glared sternly at us and wagged an authoritative forefinger. "Just remember!" he warned. "If it starts to sprinkle, *get out of there, quick!*"

For the first mile or so out of town our two wheel tracks clung precariously to the top of a low, narrow dike. Then we came to a sheep fence, and letting ourselves through the gate, we found the dike at an end. Beyond that point we had our choice of a dozen "trails" which wandered willy-nilly over a broad, white expanse, as desolate and barren as the bed of a dry borax lake. Rising abruptly to the right and left of the flat were rocky, brown mountain ranges, and ahead of us the South rim of the valley was lost in a misty blueness.

Mindful of advance warnings, I eased the car along half dubiously. We had driven about half a mile when the first of the treacherous "dark" spots suddenly appeared. I swung sharply aside and halted the

▲ The largest spring in the flat below
terrace occasionally displayed eruptive peri
of unusual agitation and churning. At th
times the water showed its highest range
temperature

< THE AUTHOR inspecting one of the opaline collars that have formed about the larger geysers on the terrace

∨ MANY OF THE ACTIVE GEYSERS are surrounded by mounds such as this one, composed of opal fragments loosely joined together in a form resembling coral

car. Wheel tracks showed where other recent travelers had failed to spot the bog in time. Pulverized greasewood, mud-plastered burlap sacks, chicken wire, and splintered boards showed that a long and laborious struggle had been necessary to free the vehicle that had plunged into its hubs. From that point onward dark spots appeared with increasing frequency, but eternal vigilance and a five-mile-an-hour pace kept us free of trouble.

So intently had our eyes been riveted on the flat ahead that we were nearly to our destination before we first glimpsed the jetting steam and water. This was it! Mentally, I apologized to the old miner whose veracity I had doubted.

Soon we were close to the rocky hills bordering the flat on the east. We were traveling at the foot of a sinter terrace that stretched along the range for a distance of a half mile or more, its rim about 250 feet above the valley floor. Chiefly white, the terrace was streaked with shades of yellow, rose, and brown, and steam spiraled from it in a dozen or more places. Additional steam was rising from a group of hot-water pools situated on the flat near the base of the terrace.

THE AUTHOR'S CAMP in the Valley of Geysers. Despite the presence of water, the ntire flat is virtually barren of vegetation, resumably because of the chemical content f the springs on the soil

The largest of these lower springs was shaped like a twelve-foot morning-glory. A small opening ten feet below the surface connected it with the subterranean water supply. For a few minutes after our arrival, the pool lay so clear and quiet that grains of course sand were plainly visible on its floor.

Gradually, gas bubbles half as large as a man's head began rising from the submerged entrance, and the water started creeping up the sides of the rock basin. Within a few minutes the surface had risen a foot. It was pulsating and churning vigorously and beginning to overflow the pool. Gas bubbles were now escaping with such intensity that the water level in the central portion of the spring was six to eight inches higher than on the sides.

As excess water drained away, the pool gradually settled back to its normal level and in a short while again stood motionless, without ripple or quiver. Timing the operation, we found that the complete cycle of rising, overflowing, and subsiding was repeated every twenty minutes. During the period that the water stood quietly, its temperature registered around 162 degrees F., but at the apex of its eruption, the thermometer showed a temperature of 170 degrees—only about 33 degrees below the boiling point in this elevation of nearly 5000 feet.

Six feet away was a small spring where the water showed less movement and slightly lower temperature; and fifteen yards to the southwest lay a third spring in which the water likewise rose at twenty-minute intervals. Strangely, the low stage of this pool appeared to coincide with the high period of the largest spring.

Owing to the high alkalinity of the deposit, the entire flat was virtually barren of vegetation, but one of the near-boiling springs was completely enveloped in a jungle of salt grass—a jungle that swarmed with the largest and hungriest mosquitoes in all Nevada!

We found that water from the big spring, though not exactly pleasant, was far from unpalatable. A pint jarful collected here showed a mineral content of 1100-odd parts per million—a count that health experts frown upon but do not consider positively injurious. Were one contemplating actual use of the water, consideration would naturally have to be given to the type of minerals it contains. Water from the big spring contained 415 parts silica—an extremely high figure—but experimentation with a cake of toilet soap showed that it hadn't the slightest trace of hardness. There was no odor of sulphur, generally so prevalent in areas of thermal activity.

A dozen plumes of steam rising from vents in the big terrace directly above us tempted us to explore, but as the sun already was dipping low over the range to the west, we decided to make camp and wait till morning.

But there were a vast number of clouds in the sky, and they were entirely too red. They spelled rain. We had already seen enough of the alkali flat to realize what danger rain could bring, for once the top crust was uniformly moist, it would no longer be possible to detect the treacherous pockets beneath.

Several times in the night I awoke and peered hopefully from my sleeping bag, each time praying for the sight of stars shining in a clear sky. But each time I saw only fast-scudding clouds that covered and uncovered the moon. Periodic flashes of lightning revealed ghostly white spirals of steam still rising from the terrace, and an occasional low rumble of thunder threw over our camp a strange eerieness.

About dawn we were awakened by king-sized drops of rain splashing into our faces and spatting on the car and the canvas tarpaulins covering our beds. We lost no time getting into action.

As we hurried through our breakfast, my eyes shifted from the rain clouds to the terrace that beckoned so enchantingly.

Dora read my thoughts. "Why don't you go on up there?" she said. "I'll stay here and pack the car, and we can leave the minute you get back."

Although fully mindful of the old storekeeper's warning, I wanted so much to view the terrace that I grabbed my camera and tripod and headed up the steep, rocky slope at the best speed I could muster in the half light of 5 A.M.

Little vegetation grew on the mineral-impregnated slope except at one point where an overflow of iron-laden water from the geysers had cut a red sluiceway down the wall. Closely bordering the vile-looking stream was a luxuriant fringe of shooting stars, or wild cyclamens—the only ones we noted anywhere in the vicinity.

It was a difficult climb, at times very steep. The overflow of water had saturated large areas of the soil, leaving it slick as grease. Reaching my destination, I pulled myself over the sharp lip of the terrace and looked out upon a rocky ledge, nearly 100 feet in width and a half mile long. An amazing color-streaked ledge, it was strewn with every variety of thermal activity, from low-spouting geysers and hot bubbling springs to blubbering mud pots and subterranean caves. The roarings and rumblings were unearthly—nearly as ominous as the thunder then rolling over the desert mountains to the east.

Although it was nearly sunrise, the sky was dark with heavy clouds, and the light was very weak and inadequate. I determined, however, to photograph as many of the springs and fumeroles as possible, and, at the same time to take a census of their number.

All the active geysers were surrounded by mounds of siliceous sinter, largely composed of opal fragments loosely cemented together in a form resembling coral. In some areas this opal showed a distinct blue-green cast, due, presumably, to the presence of algae. Other sections of the terrace presented a smooth surface of solid white opal, exhibiting occasional glints of rose or iridescence. Of the mounds surrounding vents, few were more than a foot in height, but one I noted had built up an opalescent collar at least three feet thick. Blocks of basalt, which had lodged on the terrace after rolling down the steep slope above, had also been covered with layers of the sinter.

While nothing about the mud pots appeared especially unusual, Nolan and Anderson tell us in their monograph that ten per cent of the mud consists of diatoms, which the U.S. Geological Survey has classified into ten species. Of these, three were noted as "rare," two as "frequent," and five as "common."

In my necessarily swift census, I counted 57 vents or boiling springs—many of them hot little pools not more than 12 to 18 inches in diameter. A considerable number of these showed gas bubbles and a small overflow but could not properly be said to erupt. Altogether, I feel certain that the area must embrace more than 100 live outlets, as well as a great many apparently inactive vents.

The sky was growing darker, a chill wind was coming in gusty blasts, and the puddle-sized raindrops were striking with increasing frequency. So I reluctantly left the strange scene and hustled down the steep face of the terrace to join my partner, who was waiting for me.

Since we could still see the wheel tracks we had made the previous afternoon, our crossing of the boggy flat was accomplished in short order. Reaching the safety of the dike, we halted momentarily to look back.

We could still discern the summits of the Cortez and Shoshone ranges, now raked by dark, rolling storm clouds. Between them, however, lay only an ominous blue-gray void. Whirlwind Valley, with its steam jets, mud pots, and strange sinter terrace, was completely lost to view in a black downpour.

▲ THE SPOONBILL holds its neck straight in flight, unlike its heron and egret neighbors

the ROSEATE Spoonbill

It has gained ground in Texas and Louisiana but remains rare in Florida.

By HUGO H. SCHRODER

Photographs by the author

YOUNG roseate spoonbills are not born with a silver spoon in their bill. In fact, in spite of their name, they emerge from the egg without any spoon! Only adults have the unique flat bill that has earned them their name. The bill of the chick more nearly resembles that of a duck, and some time must pass before the broadening becomes evident.

Though an adult spoonbill is not a handsome creature when viewed head-on, its plumage was a much-desired commodity in the days when traffic in bird feathers was unlimited. In Texas, Florida, and Louisiana, where the spoonbill was once numerous, settlers and plume hunters killed it ruthlessly. Its feathers are pink, with vivid carmine on the wings; and fans made of the wings brought an attractive price. Like egrets, the curse of beauty almost led to the complete extinction of the spoonbill before feather traffic was outlawed and protective legislation passed.

Today egrets are commonly seen over a wide area, but spoonbills are still quite localized in their nesting. They have made a welcome comeback in Texas and Louisiana, but in Florida there seems to have been no halt in their decline. A small number still nests in certain regions of Florida, and they are known to wander into other parts of the state during summer and early fall, but the sight of a "pink curlew," as they are locally known, is a red-letter event to most bird observers.

I had been in Florida nearly a decade before I discovered my first spoonbill. This was in Mosquito Lagoon, east of Titusville, and several years later I saw another wandering spoonbill there. They have been seen in this area by other observers from time to time.

But I had to go to Texas to see spoonbills nesting. There I saw considerable numbers on islands in Galveston Bay—islands under protection of the National Audubon Society. Several hundred pairs nested there, along with American egrets and various other herons.

What a beautiful array of spoonbills I found one day, strung out from a sand bar in the bay—some 60 of the pink adults, lined up in the shallow water—a wonderful sight! On one island there were numerous spoonbill nests in low shrubbery, all with either eggs or small young. One nest contained two eggs and two youngsters, one just emerging, so I had an exceptional opportunity to record how the infant's bill appears at birth.

The other island contained a larger spoonbill nesting concentration. These nests had to be viewed from a distance; but it was possible to observe and photograph the birds from a hide-out in the shrubbery. All the nests appeared to contain well-grown young. There were frequent squabbles between neighboring spoonbills and between the spoonbills and their egret neighbors.

Roseate spoonbills nest only in tropical and subtropical regions and breed from the Gulf southward to the pampas of Argentina. Low shrubs and trees are favored nesting sites, but they have been known to build their nests on the ground. Nest building begins soon after the birds pair off and is completed during the mating period. This is a busy time for the male, for it is his responsibility to guard the territory from enemies and to gather the

nest-building materials. He delivers twigs and sticks to the female, and she works them into the nest.

Spoonbills brood once a year, and on the average, two or three eggs are laid. The incubation period is about three and a half weeks, during which the male relieves the female at intervals on the nest.

Although the feeding of the young in the nest was always too distant for me to film successfully, I was able to observe the procedure. When the parent spoonbill returned to the nest with a supply of food, Junior would thrust his bill into the side of the parent's bill and partake of his dinner. When the young leave the nests, they learn to search for food in the shallow waters where the spoonbills regularly feed.

The feeding process is an unusual one. Moving about in the shoals, the spoonbill swings its bill from side to side until the prey is located. This motion seems to be instinctive, for Robert Porter Allen, in his thorough study, *The Roseate Spoonbill* (National Audubon Society, N. Y., 1942), points out that hungry spoonbills in captivity will "wag" their bills even when food is not available. The bird does not scoop up its prey but rather grips it, forceps-fashion, between the tips of the bill and then lifts and shakes its head, sending the food into the throat. The bill is equipped with sensitive nerve endings that are valuable "feelers" in muddy waters, where prey cannot be seen.

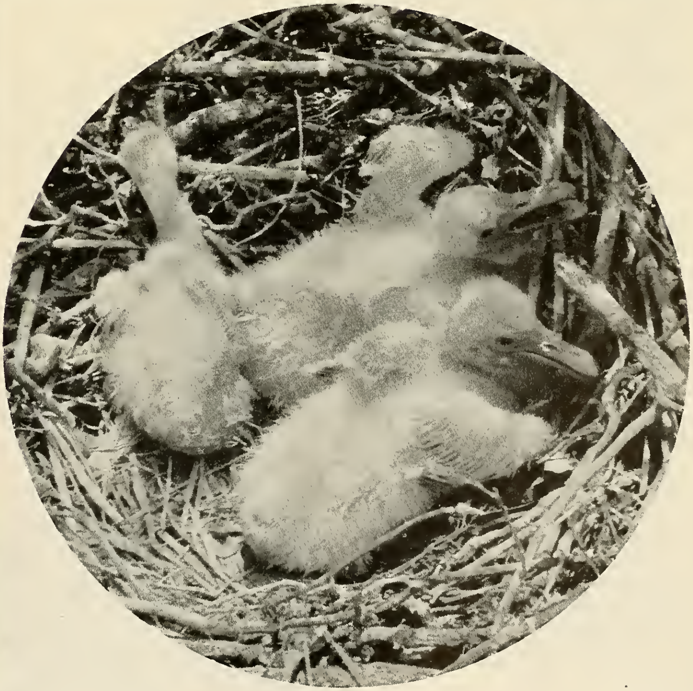
Spoonbills frequently raise their wings for balancing when moving about in the treetops. They present a colorful picture in flight, with the pink of their plumage outlined against the blue of the sky. The dark carmine shows beautifully on the wings with each downstroke, and is particularly vivid when a flying bird makes a sudden turn at close range. The spoonbill holds its neck straight in full flight, unlike its heron and egret neighbors. When coming in for a landing, the bill is pointed downward.

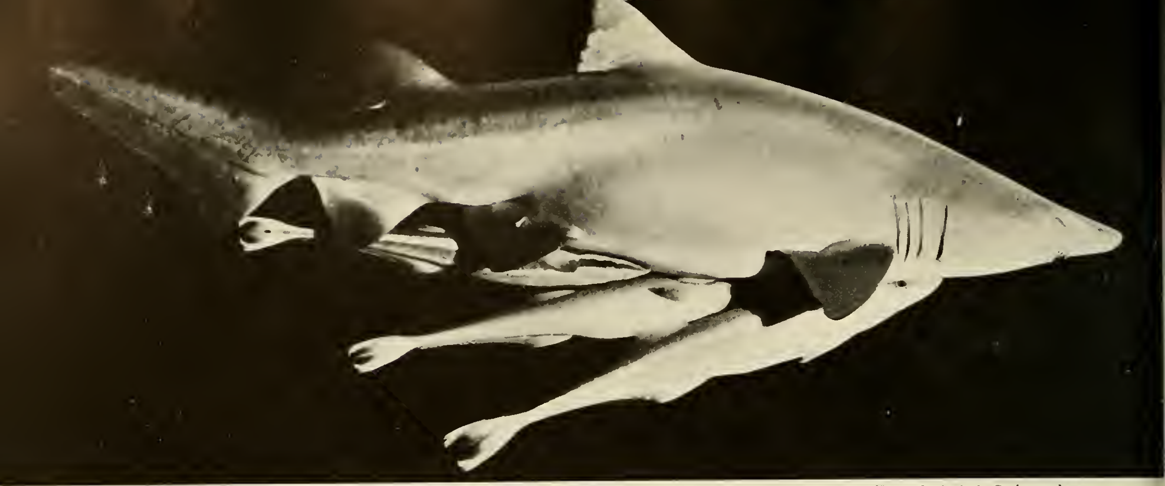
Leaving the islands of the spoonbills was like leaving a beautiful flower garden. The vivid markings on the bird's wings, in contrast with their delicate pink plumage, presented a sight long to be remembered. That departure was made on a June day in 1941 and was my farewell to the "pink curlews," for in the intervening years not a single roseate spoonbill has come my way.

Spoonbills in flight can be seen among other large birds in the entrance exhibit to the Hall of the Biology of Birds in the American Museum of Natural History.—Ed.

◀ ROSEATE SPOONBILLS and an American egret in Galveston Bay, Texas. The spatula-shaped bills are clearly seen when the birds perch in the treetops

▼ A FEW DAYS OLD: At birth there is no sign of the spoon-shaped bill that distinguishes the adults





New York Zoological Society photo

▲ REMORAS attached to a Sand Shark. They will share the shark's meal when he finds it

HITCHHIKER of the Sea

The fish that rides free to its meals lends itself to one of the strangest fishing methods known

By N. J. BERRILL

McGill University

WHEN Columbus returned to the Caribbean the year after his first voyage of discovery, he was in less of a hurry to get back to Spain and took more time to explore. He found Cuba to be a lovely island, and it was during a leisurely voyage among the islets off the south coast, which he called the Gardens of the Queen, that Indians came in a canoe to hunt turtle with a fish.

The Admiral himself watched while they fastened a cord to the tail of a curious fish and let it go down into the sea with the line held to the canoe. The explorers who were with him recorded their observations as follows: These fish "have a large mouth all full of suckers like a cuttlefish, and they are very daring, as ferrets are here. And when they are thrown into the water, they go to fasten themselves on some fish; of these they do not leave hold in the water but only when they are pulled out . . . they had one of these fish fastened on the bottom of a large turtle, and they waited to get it into the canoe." The description is not quite accurate, for the suckers are not in the mouth but on the top of the head. And while Columbus was not familiar with the fish, it is one that was well known to the ancient civilizations of the Mediterranean.

The fish was the Remora (pronounced REM-o-ra), otherwise known as the Shark-sucker. Its peculiarity is that its dorsal fin, which starts life like the dorsal fin of most other fishes, changes into a complex sucker or adhesive organ shaped like the sole of a shoe and divided into many compartments. The fish uses the sucker to hitchhike from one place to another. By means of suction it attaches itself to any convenient large swimmer of the seas, whether it be a shark, turtle, porpoise, or even the manatee, which Columbus called the mermaid. This is pure laziness, for what the remora gets is a free ride to a free meal. It attaches by the back of its head to the lower side of its traveling companion and hangs on till the meal is reached. Then it drops off long enough to join in the feast, after which it reattaches and goes for another ride. And there is little doubt that the hull of a ship looks as good to the remora as the belly of a shark.

There is a very old legend that the remora can slow down sailing vessels and even stop them altogether. We repeatedly find the idea in medieval and classical literature, and the fish was often drawn on Greek and Roman vases. In fact, the death of the Emperor Caligula was attributed indirectly to a remora, which was supposed to have fastened to his great galley and held it back while the rest of his fleet escaped. Its scientific name, *Echeneis,* itself means "holding back," and older writers usually referred to it as the Ship-holder. The remora is never big enough to exert much force against a moving boat. One kind reaches a length of about sixteen inches, and another about three feet. There is little doubt, however, that a rowboat or small sailboat would be slowed down by one of these underwater hitchhikers, and several of them might make their presence known to the oarsmen of a larger boat. Mark Anthony's delay and defeat at the battle of Actium was also supposed to have been caused by the attachment of many suckerfish to his galleys. Perhaps any excuse was better than none, especially when Cleopatra may have been the real reason.

The remora fastens itself very tightly. It has been reported, for example, that when one is attached to the glass of an aquarium, it will hold so firmly that the sucker is left attached to the glass, and the fish is so injured that it dies.

Another old name for the suckerfish is the "Reversus," from the mistaken idea that the fish swims on its back. It does give that impression, but it actually swims in the normal manner.

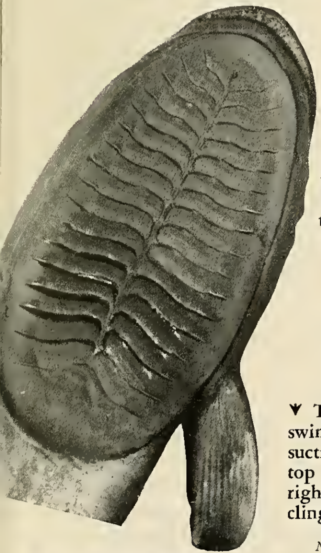
According to reports left by Columbus and his companions, the Caribbean Indians caught these curious fish when they were young and raised them in pools. Before and after a hunting trip below the sea, the Indians would talk to the fish, cajoling and praising them as though they could understand.

There is something very strange in the widespread use of this method of fishing. It reflects either the wanderings of mankind or the tendency of men throughout the ages to use their ingenuity in every possible way to obtain food beyond their reach. There is no doubt that man is inherently lazy and will make someone work for him if he can. But is it not surprising that the remora is employed to hunt fishes, turtles, and other sea animals, with a cord fastened to its tail, not just in the West Indies but in Malaya, China, the Spice Islands, and northeastern Australia? Chinese, Polynesians, Melanesians, and Australian aborigines isolated from the rest of the world for thousands of years, as well as Carib and Lucayan Indians of the West Indies, all use or have used the same fish in the same way. It does seem more reasonable to believe that the statement "Great minds think alike" accounts for this widespread practice, rather than that the method was discovered only once and was then carried over so large a part of the world.

The aborigines of the Barrier Reef angle for suckerfish with hooks made from pearl shell or bone fastened to woven bark lines. Then they fasten the fish by the tail and keep it in shallow water until it is time to hunt for turtles. In leashing the fish, a hole is made at the base of the tail fin by means of a turtle bone, and one end of a very long piece of string is inserted and made fast to the tail. A short piece of string is also passed through the mouth and out the gills, securing the head end, and the fish is slung over the side of the canoe. When a turtle is sighted, the short piece is pulled out of the mouth, and away the remora goes. As a rule, just before the fish is released, the disk and shoulders of the sucker are scrubbed with dry sand to remove the slime and excite the fish.

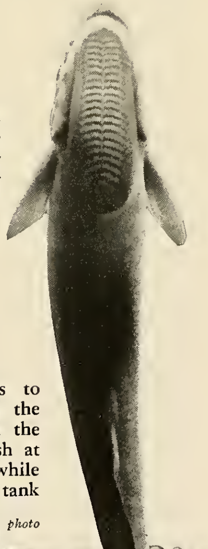
So long as the line is kept taut, the remora cannot let go of anything it has caught, and the size of the turtle or fish that can be captured is limited only by the strength of the line and the breaking strain of the remora itself. Turtles up to 100 pounds have been hauled to the surface in this way. But when the turtle is very large and clings to the bottom (and green turtles can weigh several hundredweight!), the natives dive overboard and follow the line down to the turtle to secure it with a rope.

One little difference stands out between the customs of the aborigines of Australia and the gentle Indians described by Columbus. Whereas the Indians endowed the remora with intelligent understanding and treated the fish humanely, the Australian aborigines at the end of a day's fishing eat the remora, too.



◀ THE DISC by which the shark sucker attaches itself is a greatly modified fin. Suction is created by the many slits

Woody Williams photo



▼ THE REMORA appears to swim upside down, but the suction disc is really on the top of the head. The fish at right was photographed while clinging to the glass of a tank

New York Zoological Society photo

For a detailed account of the use of remora in native fishing, the reader is referred to Dr. E. W. Gudger's study published in *The American-Naturalist* in three installments: July-Aug., 1919, Sept.-Oct., 1919, and Nov.-Dec., 1919.

Can Music Charm Snakes?

By Bucky McDonnell

An account in which an amateur naturalist and a professional scientist arrive at opposite conclusions

I SHALL tell you exactly what I observed and then, because science says, "No, snakes cannot even hear music," you will hear from a man who states his reasons for doubting the interpretations I offer. I do not promise that it will be easy for you to make up your own mind.

One morning about 10 o'clock in the early part of September, I was playing my violin on the southeast shore of Lake Tiorati, west of the Bear Mountain Bridge, New York. I was right at the edge of the dam that forms the bank on the southeast end of the lake. My friend, Art Bisson, who is a great music lover, was sitting on a camp chair, holding the music so that I could play it while looking over his shoulder from behind.

I had played several classical and semiclassical numbers, when suddenly my friend started to fall over backward, chair and all. I stepped aside and looked down to see what had caused him to turn turtle so easily. A big snake was half curled up where the chair had stood. Art said he felt it weaving in and out around his bare feet. We disposed of the snake.

Since there were many snakes in that neighborhood, we did not see anything strange about this. Art again took his position holding the music, and I continued to play. He kept looking around for more snakes, and before long he said, "Look, Bucky, here comes another one right up to me." I stopped playing. Art got rid of that snake and then sat down a third time.

It wasn't long before he said, "Bucky, you are a snake charmer. Here come two more snakes."

I did not think I was a snake charmer, so I stopped playing and watched. In a minute or two, they turned and started to crawl back to the woods. Art said, "Start playing, Bucky." I started playing, from memory, some of my own compositions. The snakes immediately turned around and came back toward us.

I said, "Well, if I'm a snake charmer, let's see if there are any more snakes," and I started to play. Another big snake came crawling out of the woods, and I watched it as it came toward us. It vibrated to the music I was playing, and as I changed the tempo of the music, it changed its vibrations. We walked around the spot in the clearing where we could watch the snake, and the snake followed me around as I played.

When I stood in one place and played, the snake came to within about six feet of me, curled up, raised its head about five inches, and just sat there like a statue until I got tired playing.

We let this snake crawl back to the woods. But when I picked up my violin and played a final tune, friend snake came back to his original place to listen. This last one, I believe, was a black snake. As I remember it, there was a black snake, a water snake, and several garter snakes that had come out.

This was my first experience, and I did not think there was anything unusual about it. I supposed that others had done it, but one day I was telling the postmaster in our town about it. He also had a camp on Lake Tiorati. He said he had never heard of such a thing, and I told him I would show him.

About two weeks later, I was sitting on a stool near his camp, playing my violin, trying for all I was worth to bring a snake out of the woods. Nothing seemed to happen. The postmaster and his guests started to kid me. Then a boy came around the bend and said, "Did you see that puff adder right back of you?"

I turned around to look, and there the snake was, sitting about three feet from my head on the dam, in exactly the same position as the first snakes I had "charmed." I stopped playing, and soon it went away. I played again, and it came back.

Then I tried something new. I put my violin away and got my mandolin. I played to the snake for about ten minutes. It never made a move to go but seemed to be in a trance.

Since then, I have mentioned this

story to many and have not found anyone who has charmed snakes with a violin or a mandolin. Many people did not believe my story and invited me to demonstrate. I have proved the thing to many of these folks.

Not long ago, my friend Charles Kenny of the New York *Daily Mirror* heard about this. He talked it over with many of his friends, and they all thought it couldn't be done. This was especially true of Herman, Charles Kenny's farmer, who worked on the Kenny's Connecticut farm. Charles Kenny, incidentally, also plays the violin, and Herman knew where there were black snakes.

One day, Charles invited me up to his farm for a week end. I said, "All right, I'll bring the fiddle, but I won't promise anything. I only know that it attracts New York and New Jersey snakes."

At the Kenny farm the following week end, Herman told me of his doubts about snake charming. Charles tried to tell him that I was an honest fellow, but Herman only looked dubious. In addition to my own violin, Charles had five others ready for the demonstration.

Saturday morning was beautiful—warm sunshine and a nice southwest breeze blowing over the countryside. Charles said, "Is it all right for a little snake charming?"

Charles took his fiddle, and I took mine. His wife and son went along. Herman ushered us to a place on the farm that looked like black snake country. Charles and I played together. Nothing happened. We played and played—still nothing happened. Herman seemed satisfied, but Charles still had faith in my word. I concluded that there just weren't any snakes within hearing distance. Herman was sure there was at least one.

We were all about to give up when Charles suggested I play alone. I did, and in about two minutes Herman's eyes almost popped out of his head, and his brow wrinkled. "Mr. Kenny," he said, "look at the big black snake coming along the wall." There was Mr. Black Snake half out of the rocks coming toward me.

I said, "Now you fellows stay here, and I'll go on the other side of the wall. If the snake goes through the field-stone wall, you will know the violin is causing him to do it."

I played on the opposite side and, in about a minute, the black snake went through the wall and crawled to about six feet from me. The snake curled up, raised its head about six inches, and sat as if in a trance. I played to him for about ten minutes.

Herman shook my hand and said, "I'll believe anything you say now, Bucky." Charles was also surprised and impressed. He only seemed to worry that his playing had not appealed to the snake.

Having had these experiences, you may understand that it is a bit difficult for me to reconcile actual observation with expert testimony, which says that snakes do not have an eardrum and cannot be assumed to hear music.

* * *

Charles M. Bogert, Chairman of the Department of Reptiles and Amphibians at the American Museum of Natural History, comments on my observations as follows:

"Several investigations have shown that hearing in snakes is defective, if not altogether absent. And it is well known that the flutelike instrument of Hindu 'snake charmers' has nothing to do with the reactions of the cobras used in such spectacles. These snakes characteristically raise the forward portion of the body and spread the so-called hood when disturbed. They simply focus their attention on the moving object nearest to them and follow its movements. The cobra would perform its 'swaying dance' in front of the swaying fakir in the same manner regardless of whether the instrument were played or not.

"Unfortunately, some of the scientific experiments performed to test the hearing of snakes have not been sufficiently well controlled to prove very much. E. Mangold reported that in 1913, when a trumpet was sounded near snakes, there were changes in the breathing rate and other responses. Ten years later, F. B. Manning made tests with rattlesnakes and found that they were unaffected by loud sounds (in octaves with vibration rates from 43 to 2752 per second) produced in a receiver scarcely a foot away from their heads, except in the case of the lowest notes. A Japanese investigator, Ryo Kuroda, observed the breathing responses of nineteen different kinds of snakes and obtained no evidence that they could hear a loud bell.

"One of the difficulties in controlling such experiments lies in the fact that vibrations from sound are transmitted to the body of the snake through the substratum—the floor of the cage in a laboratory and the ground in natural surroundings. This accounts for the apparent hearing in snakes in spite of the fact they have no tympanum, or eardrum. The bone that ordinarily leads from the inner ear to this membrane in other reptiles is in most snakes attached at its outer end to the bone that forms the support for the lower jaw. Thus the response that Manning obtained with the low notes could have resulted from vibrations transmitted through the body of the snake to nerves more closely associated with the sense of touch.

"A somewhat more reliable way of finding out whether snakes actually hear was employed by E. D. Adrian in 1938. Using suitable apparatus to detect nerve impulses, he found that loud sounds failed to produce any kind of activity in the nerve known to be concerned with hearing in other vertebrates.

"Inasmuch as the sounds produced by Mr. McDonnell's violin or mandolin could have been transmitted through the ground to the tactile nerves of the snake, the question of whether snakes can actually hear in the ordinary sense of the word is perhaps more or less academic. It does seem doubtful, however, whether vibrations of the intensity produced by the musical instruments mentioned could have carried for any distance into the 'woods.' If these vibrations were transmitted to the body of the snake, why should it respond by approaching the source of the sound? I know of no evidence to indicate that snakes employ auditory cues in finding either their prey or their mates.

"On the other hand, black snakes (*Coluber constrictor*) are apparently attracted during the mating season by movement. Several naturalists have observed that these snakes will sometimes approach and investigate the movements of a person. In Arizona, Mr. William Woodin, III and I were trying to capture a racer (*Masticophis flagellum*) by approaching it slowly in order not to frighten it. As we crouched on opposite sides of the motionless snake a few feet away from each of us, it suddenly started to crawl with moderate speed in the direction of Mr. Woodin, who remained as still as possible. To his astonishment, the snake paused briefly as it reached his trouser leg, and then, with rather deliberate movements, seized with its mouth a fold of Mr. Woodin's trousers. Seemingly the action was an investigatory one, although the interpretation of such field observations is of necessity speculative.

"The point I wish to make, however, is that the sounds from the musical instruments may have had nothing to do with the behavior of Mr. McDonnell's snakes. The behavior of the black snake suggests the possibility that the movements involved in the playing of the instruments might have attracted the snake. My guess is that if he had gone through the motions of playing without producing any music, the snakes would have moved in to investigate just as readily as they did when sounds were emanating from the violin or mandolin.

"Mr. McDonnell does not mention having kept a careful record of the times and conditions when he may have sat playing his instruments without attracting snakes. Anyone playing a musical instrument near Lake Tiorati, or just sitting, for that matter, is almost certain to see a snake from time to time. No information is supplied here to exclude the possibility that the snakes' vision was involved, as pointed out above. And absurd though it may seem, olfaction should not be completely ruled out. Odors indetectable to human nostrils certainly register in the olfactory organs of a snake, but this is unlikely to explain the attraction of a violin or mandolin.

"Quite candidly, on a basis of what is known about the nervous system and the behavior of snakes, it is unbelievable to me that the interpretation offered by Mr. McDonnell is correct. However, in expressing my skepticism, I am not seeking to deter anyone from adding to our knowledge concerning the creatures of the wild. I am only urging that observations be reported objectively, with a clear distinction made between what was actually seen and what was merely inferred—perhaps erroneously. Also it is necessary that the circumstances surrounding the observations be given in some detail."

LUNGLESS SALAMANDERS

Continued from page 304

"bridge" (if one ever existed) across the Atlantic. Thence they could conceivably have migrated to Europe, where they are now found. It seems unlikely that the European species could have been accidentally carried in ships, because salamanders are not known to "hitchhike" with cargo the way some other animals do. Also, it would be hard to explain how the European species could have split into two races in the short interval since the earliest voyages.

Today about 85 species and subspecies of plethodontids are known from the United States. There are many species in Mexico and Central and South America. New species are constantly being described by the more than 20 salamander detectives investigating salamander abodes in the different parts of the country. They study salamanders meticulously and often find that among uniform patterned salamanders and those otherwise alike in nature, several species and subspecies are discernible after close study, including the use of such tools as statistical analysis.

Herpetologists are often impressed by the variety of patterns and colors that often blend into a salamander's background. For example, Moore's salamander, *Leurognathus marmorata,* is so mottled above with shades of buff and gray that the salamander is difficult to discriminate from the stream bottom. On the other hand, contrasting characters are not so easily explained. The red-cheeked salamander, *Plethodon jordani,* appears to have rouged its jaws, in contrast to the deep blue-black body. The yellow-blotched salamander, *Ensatina croceater,* vividly-hued with black and orange blotches, lives in seclusion in leaf mold and beneath rotting logs in southwestern California.

Voice plays no part in the breeding process of salamanders. Actually, they have no vocal cords. But this did not prevent Professor C. C. Abbott, usually a careful zoologist, from brashly describing one of the large salamanders as having "a clear, bell-like note . . . It is a true hylodes note . . . They call, whistle, or give tongue, as you choose to express it, only in spring and at the time when the females are depositing their eggs." The call was obviously a frog call, probably a hiding spring peeper, *Hyla crucifer.* Many observers have heard faint squeaks emanate from plethodontids that were roughly handled. In all these cases the sound was probably accidental and associated with a sudden emptying of the mouth cavity. Some salamanders will go into a "death feint" when handled. This cataleptic state lasts but a few minutes, and a sudden touch or movement will arouse the creature to activity again.

It is difficult to believe that the concerted study of these small amphibians has consumed a substantial segment from the lifetime of such famous amphibiologists as Dr. H. H. Wilder and his wife, the late Dr. G. K. Noble, Dr. E. R. Dunn, Dr. Sherman C. Bishop, and many others. What has prompted these scientists to labor on salamanders, of all the manifold living forms, makes interesting speculation. Actually, plethodontids are not of any real economic value outside of their negligible insectivorous habits. Their martyrdom to science should be their most important commendation. Much has been written about these creatures, from Benvenuto Cellini's musings in 1524 over why salamanders issued out of a fireplace, to Nelson G. Hairston's excellent ecological study of plethodontids in the southern Appalachians in 1949. But far more information remains shrouded in their secretive habits.

European folklore of several centuries ago tells us that salamanders gamboled in fires without getting burned. Even today we hear people repeat the same myth, as if nothing has been learned about the creatures in all these years. Many questions remain unanswered, particularly concerning their reproductive habits. Two species (*Hydromantes genei italicus* and *Oedipus adspersus*) give birth to living young. Diligence and specialized scientific training will be necessary to solve some of the riddles. But one thing is certain—both the specialist and the amateur naturalist will always take pleasure in the pretty colors and spritely nature of the plethodontid salamanders.

EARLY "MISSING LINKS" FROM AFRICA

Continued from page 309

in association with a baboon that was contemporaneous with *Plesianthropus*. But caution bids us wait. This problem demands and will receive close study through many related branches of science. The hyena may prove to be a South African survivor from the Pliocene. In the next few years, the South African fauna may be correlated with the record from China, India, Java, and elsewhere, and then a much more definite answer can be given.

Dr. Broom studied his three genera and noted that they differed from apes in many ways, and in each of these ways they resembled human beings. They substantiated the conclusion that man and the anthropoid apes forked apart not a few hundred thousand years ago but perhaps many millions. With their small canine teeth and short jaws, these creatures were almost men. Their nearly human limb bones indicated that they could stand up and walk erect and that they did so to the exclusion of other forms of locomotion. Dr. Broom's findings thus far indicate that the female *Plesianthropus* had a brain with a volume of from 450 to 500 cubic centimeters, about the size of a large fist. It was thus not far from the range of the chimpanzee or the gorilla, the average for the female gorilla being 435 cubic centimeters. Last year a large *Plesianthropus* jaw was found, and Dr. Broom calculated that a skull large enough to go with that jaw must have contained a brain of 650 or perhaps 700 cubic centimeters—not so far below the capacity of 900 cubic centimeters ascribed to Java Man (*Pithecanthropus erectus*). Modern man usually has a brain of 1200 to 1500 cubic centimeters, although the extreme range is from 850 to over 2000. Anatole France had a 1100-cubic-centimeter brain and Dean Swift's was over 2000 cubic centimeters. Dr. Broom has noted that in many primitive races the brain may be as small as 1000 cubic centimeters or less, although a pre-Bushman race had the largest brains in the history of the world.

In structure the Sterkfontein fos-

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sil's brains were not unhuman. Dr. G. W. H. Schepers, a brilliant student of Dr. Dart's who became a medical practitioner and a well-known anatomist, studied with minute care the convolutions in casts of the brain cases of the Sterkfontein, Kromdraai, and Taungs skulls. He decided that the front two-thirds of *Plesianthropus* was "much more man-like than ape-like." The latter one-third was subhuman, he found, but at that, it approached the human brain in form. From his study of the brain cases, Dr. Schepers decided that *Plesianthropus* had some sort of speech, and that it could use its hands for manipulation of tools, rude though such implements undoubtedly were. Prof. W. E. Le Gros Clark thinks there is no evidence of speech in the brain cast.

The study, Dr. Schepers said, suggested that "these fossil primates were closely related to man's ancestral stock, if not actually Pliocene or Pleistocene surviving representatives of his Miocene or Pliocene evolutionary predecessor." No creature, he believed, could be accepted as human unless it could stand up and thus relieve its hands from the necessity for aiding in locomotion and, secondly, until it had developed some sort of speech or other means of communication. The brain casts of Dr. Broom's fossils indicated that they may have scored like little men on both points.

"The least we can say," wrote Schepers, "is that these fossil types were capable of functioning in the erect posture, of using their hands in a limited sense for skilled movements not associated with progression, of interpreting their immediately visible, palpable, and audible environment in such detail and with such discrimination that they had the subject matter for articulate speech well under control, and, having developed motoric centers for the appropriate application, they were also capable of communicating the acquired information to their families, friends, and neighbors, thus establishing one of the first bonds of man's complex social life. With all these attributes, they must have been virtually true human beings."

Emotion and Science

So vulnerable is man to vanity that some will resist the notion that these little creatures could have been our direct ancestors. To them, the fossil hunter appears always to be searching for skeletons in the human closet—unworthy forebears to sully the proud human escutcheon. Theological arguments are sometimes enlisted to support the thesis that Man, God's special creation, must not be linked with anything so lowly as a monkey. Those who yield to this conceit may take comfort in the admitted possibility that the Australopithecinae may be only our grand-uncles—closely related collateral beings not forming an integral part of the direct human stem. This may satisfy those who want to prolong the argument that we alone are God's own creatures. But meanwhile, more and more missing links are being discovered. And those who search for them are not made atheists by the fact that they are studying a creative process that took millions of years instead of an instant. Dr. Broom, for example, believes that in evolution there is a Plan and a Planner.

Naturally, the closer a given skull comes to being an exactly intermediate form, the more intense will be the argument as to whether it belongs on one side of the line or the other. Scientists sometimes differ in their interpretation of the details, but on the broad issues, there is more and more agreement as to the proper place of these important South African specimens in the evolutionary sequence. They belong much farther back than the other fossil men of which more has been written — *Pithecanthropus erectus*, Peking Man, and the others. They are apparently older than any other beings that show definite human-like traits. If you should meet them today on the South African desert, you might not at once call them human. But there is good reason to believe that they walked like men, that they used simple tools, and that they even may have talked.

BOOKS *Continued from page 295*

is a necessary adjunct to identification and to the study of insects.

The book is well arranged and satisfactorily illustrated. It is written for the amateur, and it will prove most useful to beginning students in entomology, particularly in the high school grades. Like other books of its kind, it contains much information not previously included in popular books, and the layman will find it interesting reading.

C. H. Curran

THIS LAND OF OURS

------- by Maxwell S. Stewart

Public Affairs Committee, Inc., $.30
32 pp. 36 illustrations

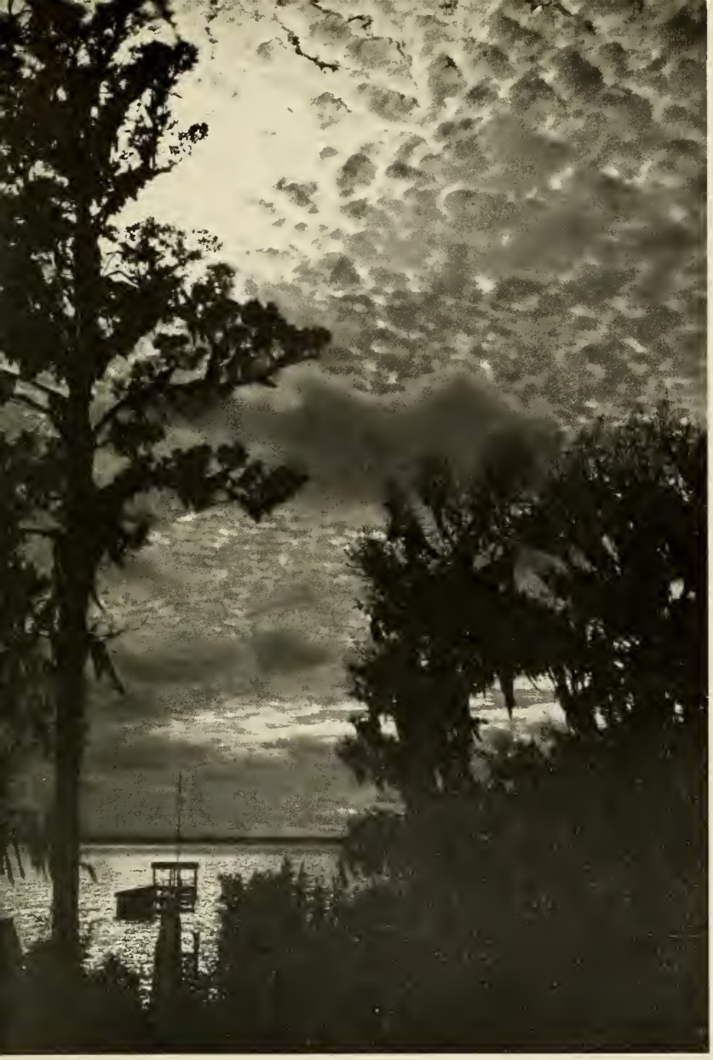
THIS unit in the extensive Public Affairs pamphlet series is addressed to and seeks to convince the city dweller that wise use of our natural resources is of vital importance to him. His dependence on the products of the land is emphasized in a series of beautiful photographs with simple explanatory captions. These cover two very different types of resources: those that are the products of a healthy land and with proper care are inexhaustible, like water, foodstuffs, and wood products; and those like coal, gas, oil, and the metallic ores that are subject to continuous depletion.

Photographs of healthy land and water and their living communities are interestingly contrasted with those showing the appearance of such areas after years of abuse. Even to laymen these should largely tell their own story.

In closing, the author points out that six out of every ten voters now live in a city and that it is therefore important for the city dweller to actively support the governmental efforts to help resource owners put conservation measures into practice.

Unfortunately, the whole presentation leans too heavily on the questionable assumption that everyone abhors resource waste and will do all he can to stop it once it is called to his attention. Human nature being what it is, the pamphlet would probably have gone much further in producing the results the Committee seems to desire if more space could have been devoted to proving that natural resource exhaustion hits the city man first, hardest, and where it hurts the most, namely in his standard of living. Much good, however, could come from a wide dissemination of this excellent piece of literature, and it is to be regretted that relatively few of the 90 million city dwellers who need its message most are likely ever to see this pamphlet, unless quantity production can lower the cost of distribution.

Richard H. Pough



At the End of a HURRICANE

By Harrison M. Reed, Jr.

PAPERS run headlines telling of a hurricane in Florida or elsewhere, with lurid accounts of death and destruction well illustrated with vivid pictures covering the disaster phase of the event. That is news! But what about the beauty of the storm? Many witnesses who have waited anxiously for a storm of this kind to pass have remarked that there was a certain grim grandeur about it all.

In Jacksonville, Florida, on the night of August 26, 1949, a hurricane came across the state from a southwesterly direction to hit this city "mildly," so the Weather Bureau said. But lights and phones went out, and highways were blocked by fallen trees and debris. By the morning of the 27th the east shore of the St. Johns River on the fashionable South Side was a riot of broken docks and tangled timbers as a result of winds that blew at 70 miles an hour with occasional gusts that reached a known velocity of 85 miles an hour. Then suddenly, on the afternoon of the 28th, the sun peeped through.

Here is an actual photograph of the tail end of a hurricane as seen over the St. Johns River from nearby San Jose community. Many witnessed this sight from various vantage points, but this seems to have been the only photographic record of the event. The local Weather Bureau states that this ending is typical of hurricanes. Suddenly, while the wind was still high, the rain squalls ceased.

The cloud layers appeared to separate, and while the lower strata (fractostratus) scudded madly onward, the upper strata (altocumulus) began to break up or coagulate into a flying mass of small fleecy clouds at an altitude of between 7000 and 8000 feet. Almost before a camera could be set up, the storm was over. Forty minutes after this picture was taken blue sky was a common and most gladdening sight, with only a few black rain clouds remaining in the distance (nimbo-stratus, seen in the background of the picture). Everywhere, of course, there was evidence of destruction, and the roar of the storm still rang in the viewer's ears. But they who came out to survey the damage were impressed by the magnificent cloud effect displayed in this mood of the elements as "Dame Nature" gathered up her winds, and a grateful people thanked their Maker that the hurricane had not been worse.

Continued from page 290

suet in a crevice in the tree, in different places.

Chickadees, Starlings, Blue Jays, and Woodpeckers all came for this suet, but the Nuthatch was the only bird that appeared to hide the food for possible future consumption. We thought that this information might be of some interest.

Charles and Irene Munzinger.
Oakland, New Jersey.

The following comments are offered by Dr. John T. Zimmer of the American Museum's Bird Department:

This interesting trait of the White-breasted Nuthatch has long been known, although the origin of the practice is not clear. The chances are that the Nuthatches do not remember the caches as a future source of food in case of shortage. It is more likely that if the store is again visited, it is in the course of a general search for food, when it is as much a pleasant surprise to the birds as any other unexpected discovery.

The Nuthatches have another procedure that suggests a possible explanation of the behavior under discussion. Since their bills are not heavy enough to be very efficient crushing organs, certain harder items in their diet may be carried off and held under foot or wedged in a crevice where they can be hammered open. Inedible portions may be left where they were lodged, being of no further use. It is not impossible that the same treatment might be accorded softer bits of food, especially if there were an abundant supply waiting competitive attention. The birds' concentration on getting a full share of the main stock might drive out recollection of the previous cache.

This is pure speculation, of course, and the concealment of food may have had some other origin. Various other birds have the same trait. It would be interesting to learn if the Nuthatches were ever seen to return directly to their stores when food was not readily available elsewhere.

Foundling Seal

Sirs:

Almost every year during the past 30 years from one to six baby seals have been driven ashore in stormy weather on Parsons Beach, Kennebunk, Maine. They are a week or less old, and until last year, no one succeeded in keeping one alive. The seal shown in this photograph was raised on a bottle. It became as dependent and affectionate as a dog and very friendly with the dog. It had free access to the river, and after about four months it departed for the sea.

A lobsterman near Jonesport, Maine, had an almost identical experience, but I do not know whether that seal departed for the sea or remained as a family pet.

New York, N. Y. Joseph Parsons.

Museum Visitors

More than 2,000,000 persons visited the American Museum during the past twelve months, according to Wayne M. Faunce, Vice-Director. Approximately 70,000,000 have visited the Museum since 1900. Annual attendance has more than quadrupled since that date and has nearly doubled in the past two decades.

In the Planetarium

During September, the subject of the lecture at the Hayden Planetarium will be "Autumn Skies."

Astronomy and Navigation

Five series of popular and informal lectures occurring once a week will begin at the Hayden Planetarium in September and October. These courses are carefully designed to clarify basic concepts in an authoritative yet not too technical manner. The introductory sessions, which provide an opportunity to ask questions regarding the scope of each course, are open to the public without change, as follows:

Modern Celestial Navigation	Sept. 20
Applied Navigation . . .	Sept. 25
Astronomy without Mathematics	Oct. 3
Young People's Astronomy and Parents' Refresher Course	Oct. 14
Star Identification	Oct. 19

All of the lectures begin at 7:15 p.m. except the Young People's Astronomy and Parents' Refresher Course, which is held at 9:45 in the morning.

A pamphlet giving additional information about these streamlined courses can be procured by addressing a request to The Hayden Planetarium, 81st Street and Central Park West, New York 24, N. Y.

Total Eclipse of Moon

There will be a total lunar eclipse on September 25, which will be visible in all parts of the United States.

Special Exhibits at the American Museum

Through Oct. 1

Famous Animals You Should Know

as interpreted by Paul Wright
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A series of eight whimsical miniature statues interpreting some famous stories dealing with birds and animals.

Through Oct. 1

Old Flower Prints

collected by Kennedy and Sons
Corner Gallery

A collection of about 50 old botanical engravings in color. Some of these prints were made as early as 1750. They are from England, France, Belgium, and the United States.

October

NATURAL HISTORY

195

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LUME LIX. No. 8

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LETTERS

Mighty Mississippi

SIRS:

Some of your readers may be interested in this photograph of the mighty Mississippi. Note that at this point, deer wade across the river with impunity. I photographed this scene last year near Lake Itasca, the source of the Mississippi, in northern Minnesota.

BATES M. STOVALL
Alexandria, Va.

Barter Mart

SIRS:

I am making for the local archaeological society, of which I am a director, a collection of minerals and rocks typical of those used by the Indians and early inhabitants of North America. I still need for this collection, specimens of obsidian, novaculite, jasper, and the several varieties of chalcedony (as described in Dana's *Mineralogy*). I wonder if any of your readers can help me in obtaining any of these. I can pay a moderate amount for good specimens but would prefer to trade minerals and rocks from the Missouri Ozarks for them.

I do not need perfect artifacts but can use broken pieces or even chunks of unworked material to show the general appearance of these rocks and minerals.

Any help to make this a good collection will be greatly appreciated.

C. H. TURNER
Springfield, Mo.

Flowers from the Crater

SIRS:

I am a student at Hiroshima-High-Normal School and am very much interested in collecting wild flowers. At Hiroshima Civil Information Education Library I found NATURAL HISTORY Magazine and am delighted with it. Within beautiful and good pages I can easily see about the animals and plants of the United States.

I hope it may be possible for you to introduce to me an amateur plant collector with whom I could exchange specimens. I could send him the wild flowers of Hiroshima City.

(Mr.) TERUHIKO KIDO
Age 20
Hiroshima, Japan

NATURAL HISTORY Magazine will be glad to forward to Mr. Kido and Mr. Turner any communications from readers interested in flowers and minerals respectively. Address: care of NATURAL HISTORY Magazine, 79th St. and Central Park West, New York 24, N. Y.

Jumping Fishes

SIRS:

In the June issue of NATURAL HISTORY you published a short article entitled "Jumping Fishes," by Bucky McDonnell, in which the author described how fishes can be made to jump out of the water by striking the gunnels of a canoe sharply with a paddle. I am wondering whether a slightly different experience I have had with fishes may interest your readers.

For years it was both my custom and pleasure to return to a cottage on the Susquehanna River a few miles north of the Pennsylvania-New York line. A college classmate joined me one summer, and we frequently rowed four or five miles upriver for corn roasts, dances, etc. In this part of the river there were several small rapids to be navigated, and to help us through these tough spots in

NOTICE—Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on these pages will be paid for at $3.00 each, with full credit to the photographer. Return postage must be included.

the dark we used a fairly strong auto headlight attached to a post in the bow or stern of our four-oared steel rowboat.

Some occasions required a bit more fancy dress than usual, and my story starts with a black night on which we were wearing white shirts. My friend was rowing in the bow of the boat when, all of a sudden, he got a wet slap in the back with an eight- or nine-inch black bass. The fish had jumped at least 2½ feet out of the water and then dropped to the bottom of the boat.

It is well known that fish are attracted by light, so we decided that our headlight had been responsible for this. Either it had made a bright spot on the boat or on my friend's shirt, or the light itself had attracted the fish and made it jump.

We then made trips at night to check our theories. We determined that if the light played only inside the boat, leaving the water dark all around, the results were surer. I should add, however, that there was nothing to boast about either as to the size or the number of the fishes.

Having proved our theory, we began to wonder whether by chance the regular nightly maneuvers of another boat we had seen had a similar purpose. It would slowly work its way up and down on the far side of the river, with a lantern in the bottom, looking like a phantom ship. There were laws about night fishing, and we felt that it was really the other man's business if he wanted to break them, so we went slowly. In time, however, we made his acquaintance. He lived in a small shack downriver. We got at the truth during a yarn-swapping session. With little idea of being believed, I timidly told of our experience of catching fish with a light in the boat. Our friend then confided that we had guessed correctly. Having only nights available, he was supplying a part of his food requirements in this way. He said there was nothing unusual about catching fish by means of a light, and he cited a case of a sunken canal boat that tipped considerably but had a dry deck area behind one gunnel. People would walk that deck at night with a lantern shielded behind the gunnel, and fish would be attracted. They would jump toward the light, and some would land on the deck and be carted home.

I was most interested in Bucky McDonnell's incident, but I do not have any explanation for these things. After many years of varied fishing, I am convinced that fishes rate high in the stupidity scale and that no one knows what is in their minds. They won't touch a good-looking worm but will take a dry fly and a cigarette butt on the same line (two hooks, of course) in the same cast. My one and only "muskie" (18¾ pounds) cost me about $25 a pound, taking all the trips and all the expenses into account—and then along comes one of them and gets himself caught on a stringer hanging to a post of the dock. But don't get me wrong. There is no thrill like seven inches of brook trout with his tail kinked against a fast-flowing stream and you on a slippery rock with light equipment. . . .

Westfield, N. J. W. R. Atwood

Catching fish by means of a varnished board sloping into the water from the edge of a boat is an ancient practice in China, where it was reported at least as early as 1685. Moonlight glittering on the board is frequently mentioned as one of the circumstances making it more likely that a fish will propel itself into the boat.

In a comprehensive article entitled "Fooling the Fishes," published in *The Scientific Monthly* for April, 1937, Dr. E. W. Gudger raised the interesting question of whether this method of fishing was carried from one region to another all the way to the Congo, where it has been observed in modified form. He finds no mention of the practice between Annam, or perhaps India, and the Congo basin. He concludes that, in all probability, the method was developed independently in different parts of the world.

Plausibility is lent this conclusion by Mr. Atwood's own story, above. Where there is intellectual curiosity, there is development in the arts of fishing. Like most fishing techniques, this one is designed to make the fish catch himself. Mr. Atwood clearly discovered the efficacy of a light in attracting fishes and unearthed the only instance resembling the Chinese varnished board technique that we have heard of in the United States.—Ed.

Dwarf Birds?

Sirs:

My interest in birds has spread to the rest of the family, including my nine-year-old son. Recently he saw a person whose growth had been stunted for some reason. Later he asked me if there were ever dwarfs among the birds. Could your ornithological department help me in answering that inquiry? Thank you.

Lorain, O. Mrs. J. C. Hageman.

The following comments are offered by Dr. John T. Zimmer of the American Museum's Bird Department:

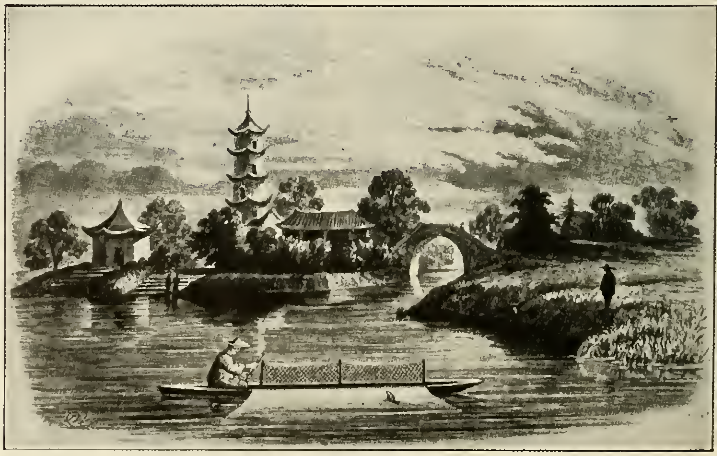
It is quite possible that dwarf individuals may hatch on occasion, but certainly very few if any of them survive. Among the many thousands of birds that have passed through my hands, I have never seen one that I could call a true dwarf. There is, of course, individual variation in size as in other characteristics, the extent of which is different in different species, but it is nevertheless remarkable how small this variation often proves to be.

A notable difference in size may occur between populations of the same species living in different regions, and numerous subspecies have been named on such characteristics. The entire population of the different area is, however, involved and within its own limits of variation is as constant in size as the other. There is also sometimes a notable difference in size between the two sexes of certain

Continued on page 384

▼ **Canvas sometimes took the place of the varnished board, as shown here. The net served to keep the fish from leaping clear over the boat. The artist seems to have erred in putting the moon on the far side of the boat**

After Fortune, 1857



NATURAL HISTORY

The Magazine of the American Museum of Natural History

F. Trubee Davison, President
Wayne M. Faunce, Vice-Director
In charge of Publications
Albert E. Parr, Director

VOLUME LIX—No. 8 **OCTOBER, 1950**

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You will find Natural History *Magazine indexed in* Readers' Guide to Periodical Literature *in your library*

THE COVER THIS MONTH

The gorgeous autumn coloration shown in Georgia Engelhard's photograph taken at Tamworth, New Hampshire, reminds us once again of the marvelous living chemistry that produces this aesthetic treat each year. What many persons do not realize is that these colors do not represent the transformation of one substance into another. The red, yellow, and purple substances are present in the leaves all through the year. But they are hidden by the green coloring matter known as chlorophyll until, at the end of the warm season, it diminishes and exposes them. Among these pigments are the derivatives of carotin, and the dye stuffs called anthocyanins (reds and purples) and flavones (yellows).

Perhaps the most pleasing effect is seen when a few green leaves remain, as in this view, and when nature's autumn palette is accented by the gleaming bark of birch, whose frosty whiteness will remain the same through the summer sun and winter snow alike.

This photograph was taken with Ansco Outdoor Color Film, at f 8 and 1/50 second, with an Eastman Kodachrome haze filter.

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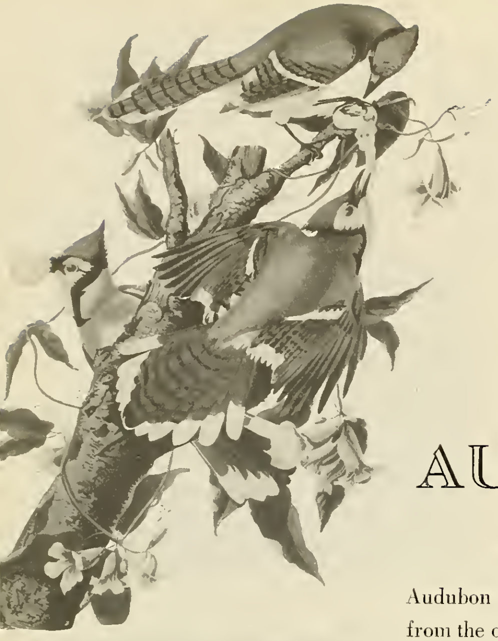

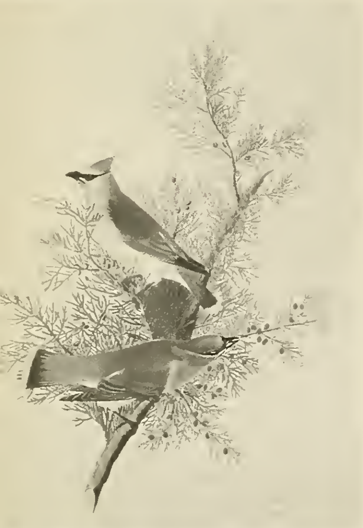

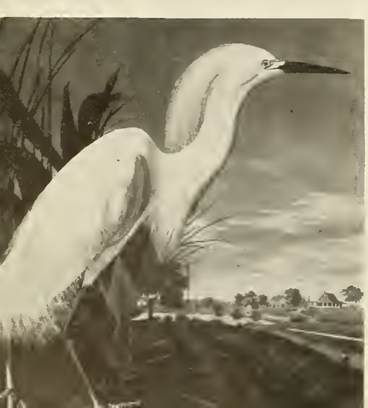

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YOUR NEW BOOKS

Science Is a Sacred Cow • Game Abundance

Africa • Fishing • Gems

SCIENCE IS A SACRED COW

- - - - - - - - by Anthony Standen

E. P. Dutton & Co., Inc.
$2.75, 221 pp.

MR. STANDEN'S blast against scientists and the science that some of them profess has been received generally with whoops of joy by the reviewers in the daily press and with scorn by the critics in the scientific journals. There is no doubt that Mr. Standen is sprightly in his attack and often funny. The pleasure, however, that scientists might be expected to take in his cracks is apt to be somewhat wry. But even the scientists trying to be "objective" (Mr. Standen doubts this state of grace) must admit that the author has a point or two.

What Mr. Standen seems to be objecting to most of the time is that science or scientists are overweening in their claims and are often wrong. He points to a long list of errors stretching back to the beginnings of science. That doesn't impress me very much, since it is well known that scientists spend a large amount of their time altering and perhaps improving the concepts and theories of their predecessors. The fact that someone one or two hundred years ago formulated a generalization that is now discarded doesn't necessarily mean that everything we believe now is similarly doomed for a future ash can. Even Newtonian physics continues to have validity.

Another gripe of Mr. Standen's, especially when dealing—none too gently—with the social sciences, is that they cannot provide the answers to various pressing social questions. No one knows this more acutely than many social scientists. That is one of the reasons they are in the business of trying to find methods that will provide the answers. Of course this won't satisfy Mr. Standen, who seems to think that social scientists will never be able to solve their problems and perhaps should not be permitted to try.

I suppose in the long run, it is a question whether you believe, as Mr. Standen evidently does, that man can arrange his affairs better by intuition or revelation, or you sympathize with the struggle of the scientist to establish a firm foundation of tested and rational understanding as a basis for society.

HARRY L. SHAPIRO

LAST CHANCE IN AFRICA

- - - - - - - - - by Negley Farson

Harcourt Brace, $5.00, 381 pp.

NEGLEY FARSON first visited British East Africa twelve years ago. In 1947, wishing to study the problems of both natives and Europeans, he traveled from Tanganyika to the Abyssinian frontier, visiting tribal chiefs, farmers, government officials, native educators, and Indian merchants. He was astonished at the unsolved issues—educational and economic. He found schools, maintained by the government, by missions, and by literate natives, "up for revision." "The white man should better educate the native for life in Africa"—provide training not only for clerks but artisans. The "frantic desire of the educated Africans is to develop Africanism" (witness Jomo Kenyatta, after seventeen years in Europe, now President of Kenya African Union and the Teachers' College).

There are still a few estates of 100,000 acres, much of which lies fallow. Real agriculture is carried on by farmers who cultivate small holdings intensively. A great majority of the 5,000,000 natives, during six months of the year, are half-starved, due to overpopulation (often 900 to the square mile), crop failure, drought, and a low water level. The native thinks the white man, not "the will of God," is responsible for his misery. To make the hungry native believe in the European's good intentions, Kenya must control erosion and overgrazing. For example, 49,000 Masai, with 700,000 cattle and several million sheep and goats, occupy only 15,000 square miles of land. Never do they kill cattle for food, but drink milk and blood extracted from the neck of the living beasts. These fiercely handsome Nilo-Hamites, renowned for intelligence, dignity, and great bravery, once dominated all of East Africa. A warrior capable today of taking singlehanded and without benefit of shield, a charging lion on his spear, is not easily convinced of the white man's superiority!

Nairobi is no longer the small peaceful town of twenty-odd years ago, when the roar of near-by lions shattered the midnight stillness of this reviewer's expedition base in Parklands where doors were never locked. Today among the "city's" 14,000 whites, 40,000 Indians, and 55,000 Africans on location, an "additional 22,000 African thieves and thugs, sleeping in warehouses, motor lorry bodies, etc. are an ugly problem."

Changed far less are the tribes of the Northern Frontier Province. The nomad Samburu still herd their flocks among giraffe, oryx, zebra, and gerenuk from shrinking rivers (wasted by farmers at the headwater) to water pans. Boran and Somali bring their camel caravans into Marsabit, the "Paradise Lake" of the Johnsons. There Farsen saw the foundation stones of the Johnson house, once belonging to the dwelling of G. F. Archer, the first white man to build at Marsabit, and the lake only a mud hole with storks digging for frogs. But elephant and greater koodoo still inhabit the cool uplands. Everywhere water is now drawn for man and beast from 70-foot ancient wells.

Farson pays high tribute to Gerald Reece, Provincial Commissioners of this heat-blasted region, and to the conserva-

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tionists, Captains Archie Ritchie and Keith Caldwell, long-time wardens of the East African game and friends of countless Americans.

There is splendid description and thought-provoking fact in *Last Chance in Africa.* Anyone who knows this magic land will read Farson's book with appreciation and nostalgia and will be impressed by his effort to estimate correctly the complex relationship between the white man and the African in Kenya.

Mary L. Jobe Akeley

THE REASONABLE LIFE

- - - - - - - - by Clifford Gessler

The John Day Co., $2.75, 214 pp.

THIRTEEN years ago Mr. Gessler published a charming account of his life on a remote Polynesian atoll in a book called *The Road My Body Goes.* From this same experience with native life he has now culled out another sheaf of recollections; this one, however, selected to illustrate the cultural factors producing "the reasonable life" led by the Napukans and designed to serve as an object lesson to the harassed, troubled, and neurotic members of our society. He describes in well-chosen examples of native behavior under various circumstances how the Napukans resolve their difficulties and manage their affairs. A clear-cut philosophy emerges from these anecdotes and recollections, and the reader is led to contrast the easy adjustment of the Polynesian to the exigencies of existence with the tenseness and maladjustment too frequently found among ourselves.

Mr. Gessler's sympathy with Polynesian life is profoundly evident, and his insight into its motivation is often remarkably acute. These give his book a warm and moving spirit that cannot help being ingratiating to the reader. This alone is enough to make the reading of *The Reasonable Life* a worth-while experience in plumbing a strange culture, even though Mr. Gessler's philosophical asides and value judgments may not be completely acceptable.

Harry L. Shapiro

FISHING THE ATLANTIC

- - - - - by S. Kip Farrington, Jr.

Coward-McCann, $6.75
312 pp., 131 illusts.

IN *Fishing the Atlantic,* the author has produced a book that should be "required reading" for everyone interested in salt-water sports fishing. It is the work of an angling expert who also is a fine writer. The style is free-flowing and a considerable improvement over the author's previous books. The introduction, by Philip Wylie, is a masterly but deserved tribute to the writer.

Fishing the Atlantic is a most interesting and authoritative book on marine sports fishing which carries the reader smoothly from Nova Scotia down along the Atlantic coast in easy and informative stages to Florida, thence around the coast of the Gulf of Mexico to Alabama, Texas, and Mexico. There are chapters on Cuban fishing, Panama, Columbia, and Venezuela, on Bermuda and Jamaica, the Bahama Islands, Sweden, Denmark, France, and South Africa.

The book is profusely illustrated with reproductions of interesting photographs, and throughout the book the author imparts to the reader important information on boats, fishing accommodations, fishing methods, fishing tackle, baits, and lures. Every famous and near-famous angling area, offshore and on, is covered thoroughly so far as sports fishing is concerned, and every species of game fish for which these places are noted is described and commented upon in language every salt-water angler can understand.

Erl Roman

THE ADVENTURES OF MARCO POLO

- - - - Edited by Richard J. Walsh

The John Day Co.,
202 pp., 68 illusts.

IN the thirteenth century the Western world was slowly awakening from the Dark Ages. Ignorance of the Orient was so total that no one in Europe believed Marco Polo when he told the story of his travels throughout Asia. He had lived many years in China, during the short period of the Tartar domination. Marco, after his father and his uncle, had been a favorite of the Grand Khan Kublai, the great Mongol Emperor. In an official capacity, he had visited many strange countries. After his return to his native Venice, he was captured in war and jailed in Genoa, where he dictated the tale of his adventures. They sounded fantastic. Yet his account is certainly true in its essence.

Today, after many years of penetration and study of Asia, Marco's story can be better appreciated. Historians and geographers, of course, are particularly interested in his descriptions, but naturalists also find much to be learned from them. He never fails to mention the animals that he finds on his way. It is not always easy to identify them, and the accuracy of some of his statements may be questioned, as he often reports on hearsay. His accounts, however, teach us a great deal about the Asiatic fauna of his day. We are struck by the evidence of the tremendous and senseless destruction since caused by man. In Kublai's empire, game was preserved for the selfish enjoyment of the ruler and his deputies, but nevertheless adequately protected, while falconry, hunting, and animal training had attained an unbelievable level of efficiency.

For those who, like the reviewer, have long traveled in Asia in complete safety and comparative comfort, Marco Polo's adventures, with all their slowness of transportation, dangers, and hardships of many kinds, take a special significance and win deep admiration. They also bring home the terrifying notion that, in our very days, Asia has suddenly become closed to Western man even more tightly than it was in the Middle Ages.

R. J. Walsh's adaptation makes the Adventures easy, pleasant reading, and C. Le R. Baldbridge's illustrations are evocative and beautiful. It is all the work of men who know and understand Asia.

J. D.

THE WAY TO GAME ABUNDANCE

- - - - - by Wallace Byron Grange

Charles Scribner's Sons, $6.00
365 pp.

THIS book is a manual of the causes of fluctuations in game populations and the practices to be adopted if the wide swings from peak to crash in these cycles are to be avoided.

Cycles in the abundance of animal life are too well established to be open to question. But there is plenty of argument as to what the fundamental causes may be. There is a periodicity to these rhythms which suggests a possible, perhaps a probable, relationship to sunspot cycles. The subject is an intriguing and important one because the forces at work on game may very well have a profound, although not so direct and obvious, influence upon human populations and man's behavior.

The author develops his thesis in an orderly manner, beginning with an analysis of the environmental background and proceeding to a discussion of plant and animal successions and the results of habitat changes. He then discusses the response of animal life to alteration of the plant environment, the nature of game cycles, and finally suggestions for the control of these cycles.

Many examples are given to demonstrate the various principles described. These are generally convincing and well chosen. Good half-tone illustrations also help to establish the thesis of the book. "The cycle, in truth, proves to be *the pattern of life* for earth's creatures.

"Climate and plants are its two great dominating forces—both terrestrial expressions of the fluctuant stars and heavens."

It is not possible within the limitations of this brief review to attempt comment on the author's philosophy. The subject is complex and has its moot aspects. Grange has, in my opinion, given a very plausible explanation both of the visible features of cycles and the invisible forces that cause them. His book is an important contribution to the literature on cycles and will be a valuable reference in the library of any nature lover.

HAROLD E. ANTHONY

A ROMAN BOOK ON PRECIOUS STONES

- - - - - - - - - by Sydney H. Ball

Gemological Institute of America,
Los Angeles, Calif., $6.50
338 pp.

THE jeweler of today would be very happy to have gems now occupy the place in business and social prestige that they filled in Pliny's day. The best English translation of Pliny's famous book, that of Philemon Holland published in 1601, has long since outlived its usefulness as a guide to the "Naturall Historie of the World" and is little read today. Many will rejoice that Holland's old-fashioned phraseology has been simplified and clarified in this new gem book, assembled by Sidney Ball and edited by Kay Swindler.

The first third of the book presents a readable and fascinating picture of the source of gems, their uses, and their working in Pliny's day, the first century of our era. With numerous quotes from the Pliny text, it sums up the information imparted by Pliny in dribbles. The second third is a complete rewrite of Pliny's thirty-seventh book, printed on yellow paper to make it stand out and easy to locate. There are many marginal notes (infinitely preferable to footnotes, one might add) which give modern English equivalents for the gem names so far as Mr. Ball could determine them. The third section of the book is made up of notes on the numerous classic and historic references of the Pliny work. This section, too, is liberally embellished with marginal notes on the references to which Mr. Ball has gone for elucidation. A hasty glance will show that he read widely and to good purpose many authors seldom consulted today.

Sydney H. Ball was a very successful mining engineer, who was particularly well-known for his work in the African diamond deposits. His hobby was gems, particularly diamond data, and for years he wrote the gem section of the *Minerals Yearbook* of the U. S. Bureau of Mines. One may feel sure that the translations of Pliny's names, for which a degree of certainty has been indicated, are as close to the correct ones as we shall ever come. The editor, Miss Kay Swindler, deserves special commendation for the fine appearance of the book, the marginal notes, and the facsimile reproductions, as well as for the unusually extensive work with the text, which fell upon her as a result of Mr. Ball's death last spring. The publishers are also to be commended for their courage in printing such a fine but perhaps commercially venturesome book.

F. H. POUGH

CASTE, CLASS AND RACE

- - - - - by Oliver Cromwell Cox

Doubleday & Co., Inc., $7.50
624 pp.

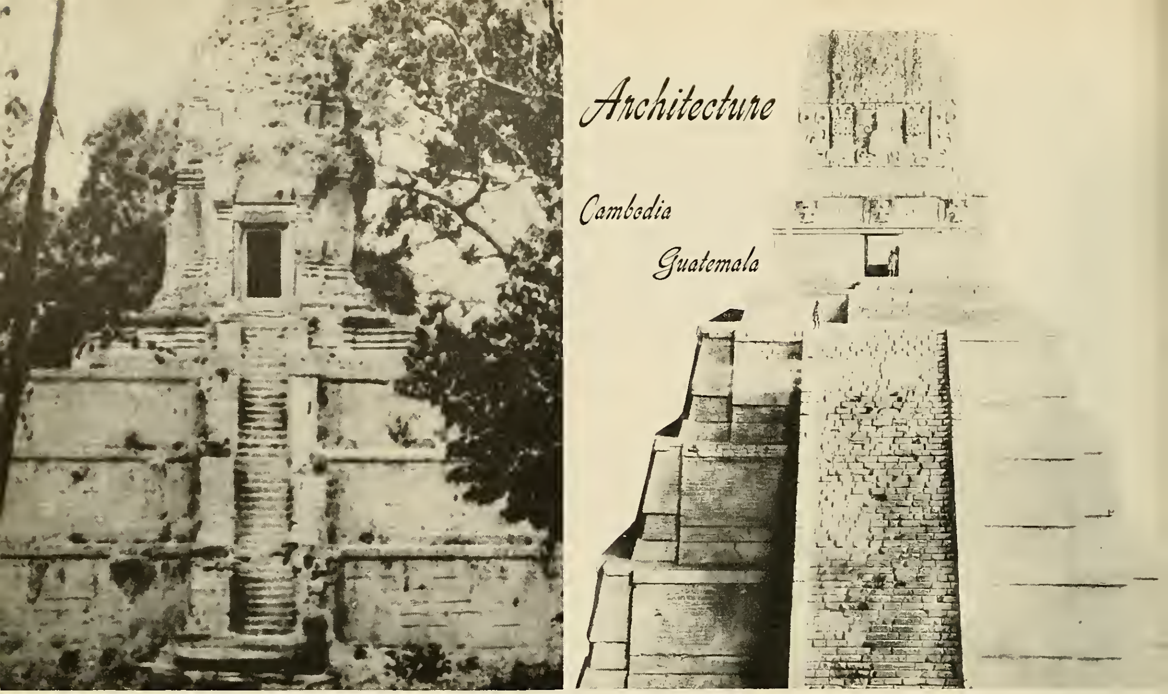
RACE conflict is one of the most disturbing problems facing the people of this country. Without a satisfactory solution to this unhappy situation, the tensions that mark race relations hover over us as a constant threat. They ramify throughout the social structure and decay its bonds. As long as we continue to ignore them, we weaken our moral strength as a people and endanger our leadership in the world.

Americans throughout their history have been aware of the dangers of racial stresses, particularly those latent in Negro-White relationships. There has never been a period from the founding of the Republic when the injustices of the Negro position in our society have not exercised some of our most thoughtful public men. And despite the outbreak of violence in the form of a civil war, which in part concerned the moral issues of slavery, the problem has persisted unresolved.

Mr. Cox in *Caste, Class and Race* has examined once again the position of the Negro in American society. He brings to the task a considerable apparatus of scholarship, a forthright and uncompromising intellectual position, and a vigor that demands attention. He rejects the assumption that the Negro has become frozen within a caste system and argues that his exploitation is rooted in the capitalist structure of American society. He is convinced that only by a socialist revolution will conditions prevail favorable to a final solution of this ancient and troublesome disharmony.

Despite the air of polemics that tinges the book, it has much to say that is worth considering carefully. And even if one cannot agree entirely with the author, he should be read, for he represents a point of view that has a number of supporters.

HARRY L. SHAPIRO



THE ALMOST identical form of these two temple pyramids from tenth-century Cambodia (*left*) and from the Maya culture of about the sixth century is indeed striking. Students who support the theory of cultural exchange between Asia and America point out similarities of detail, including the use of the corbelle vault, serpent balustrades, serpent columns, and attached column in panels. Opponents of the theory point out the many difference in the architecture of southeastern Asia and Middle Americ

Is American Indian Cultur

Most anthropologists believe that the high civilizations of Middle and South America developed without influence from abroad. A recent exhibit at the American Museum shows, however, why some scholars think there may have been traffic across the Pacific in the days before the Europeans discovered America

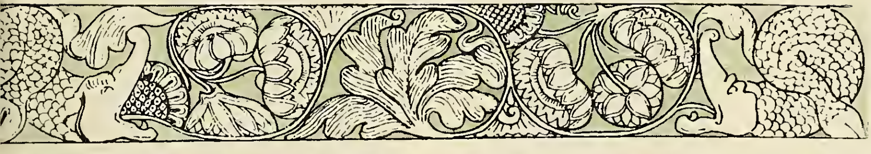
By GORDON F. EKHOLM
Associate Curator of Anthropology, American Museum of Natural History

DID the American Indian civilizations develop independently, or did they receive some inspiration or stimulation from the high cultures of the Old World? This is perhaps *the* most important question confronting those working in the field of American archaeology and seeking to make known the true history of the American Indian. It is also a question of outstanding significance to our general understanding of how civilizations come into being, of how simple and primitive cultures develop into more complex ones.

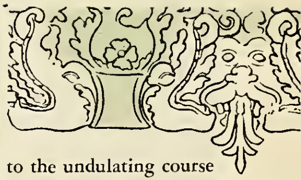
Anthropologists are in fair agreement that the New World populations—in a physical sense—belong to the Mongoloid racial stock and that they originally came out of Asia across the Bering Straits during or shortly after the last glacial period. We can imagine these early migrants and the other following groups pushing southward into warmer climates and gradually spreading out over the humanly empty areas of North and South America. They must have been

Decorative Motifs

Amarāvati. Southern India

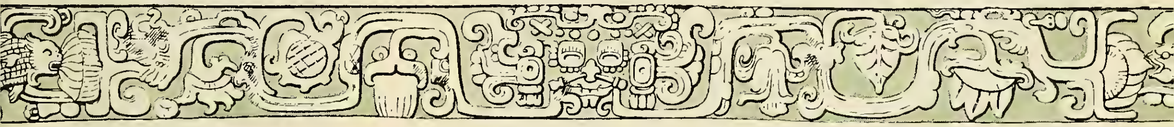


Ceylon

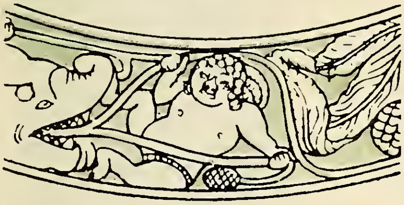


THE SCULPTURED PANELS above and below have enough elements in common to suggest historical relationship. The designs are based on the lotus plant, with the leaves and flowers accommodated to the undulating course taken by the stem of the plant. In both cases fish or fish-like creatures are placed at the ends of the patterns, and very similar jawless monster masks are used at the centers

Yucatán

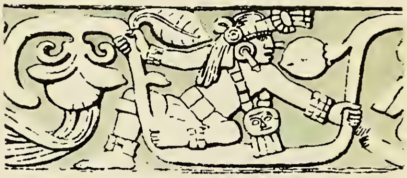


Amarāvati. Southern India



THESE PORTIONS of the same series of panels show human figures holding on to the stem of the lotus plant in a very similar way. Costumes and details are different, but the nearly identical arrangement of the figures strongly suggests a common tradition

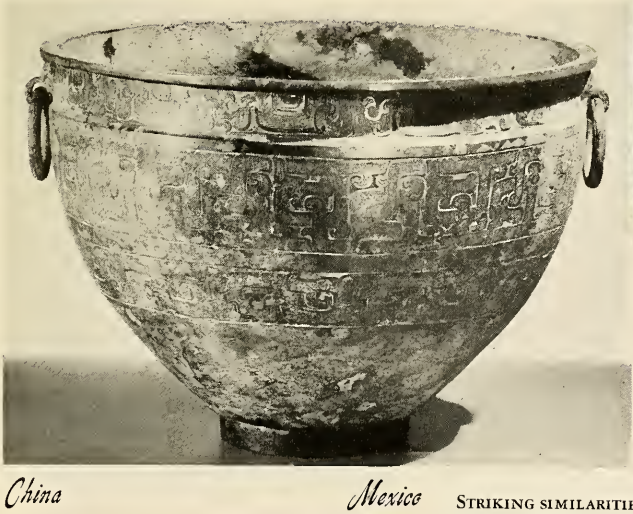
Yucatán



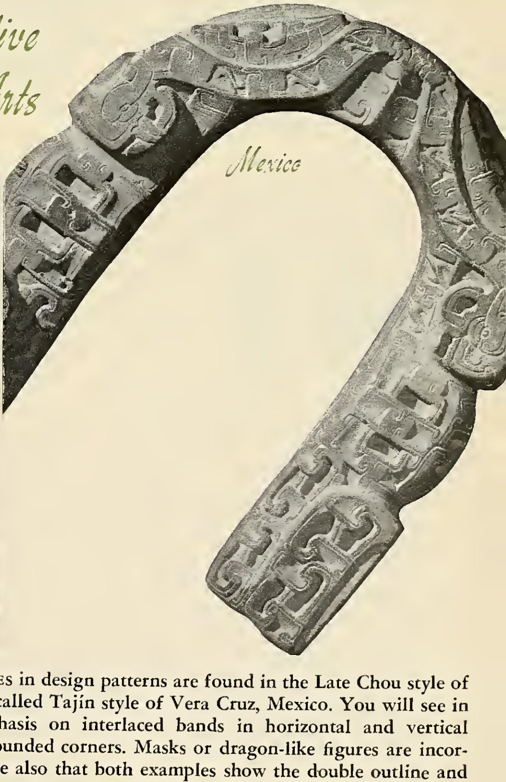
Asiatic?

Decorative Arts

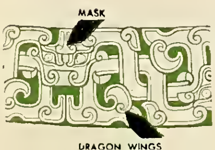
China



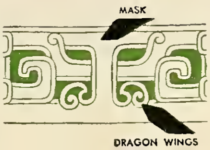
Mexico



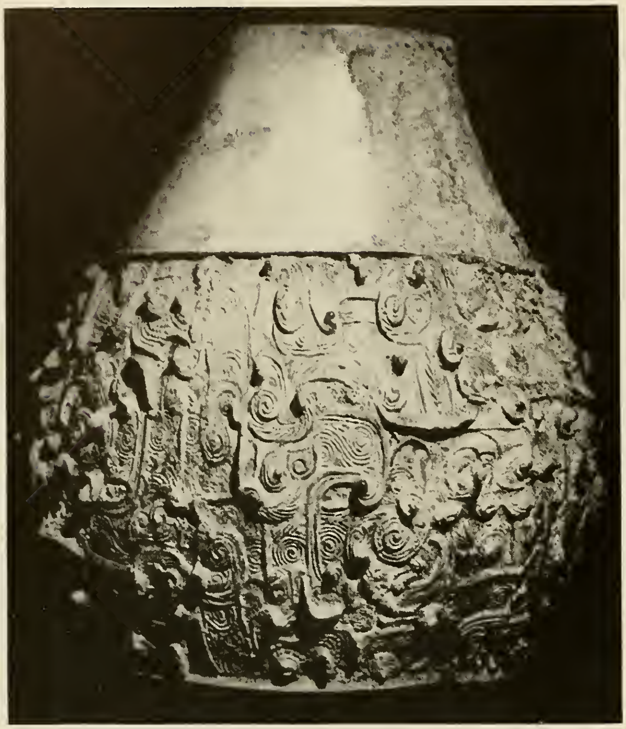
China



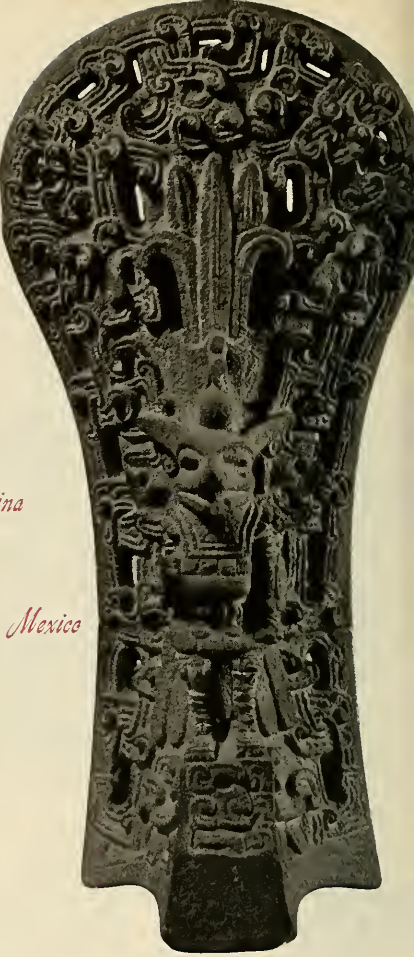
Mexico



STRIKING SIMILARITIES in design patterns are found in the Late Chou style of China and in the so-called Tajín style of Vera Cruz, Mexico. You will see in both a similar emphasis on interlaced bands in horizontal and vertical arrangement, with rounded corners. Masks or dragon-like figures are incorporated in both. Note also that both examples show the double outline and the identical use of what are known in Chinese art as dragon wings



China



Mexico

This bronze vessel from ancient China and the so-called palmate stone from Mexico have the interlaced pattern mentioned before, but in a modified form. The whorls are more tightly wound, and they spiral out from the surface. Particularly the upper portion of the palmate stone shows this similarity

equipped with a simple hunting and gathering type of culture adapted to the subarctic climates of northeastern Asia and Alaska. This is a logical assumption, and it is supported by all the archaeological evidence of early man in the New World. Agriculture, which appears to be a basic necessity for a high civilization, could hardly have been brought to the New World by this route.

Assuming then, as it appears we must, that these early populations of North and South America were culturally quite simple, we must explain how they proceeded along the road toward civilization and ultimately produced such things as the magnificent Maya temples of Central America and the detailed and efficient governmental system maintained by the Inca in the Andean regions of South America.

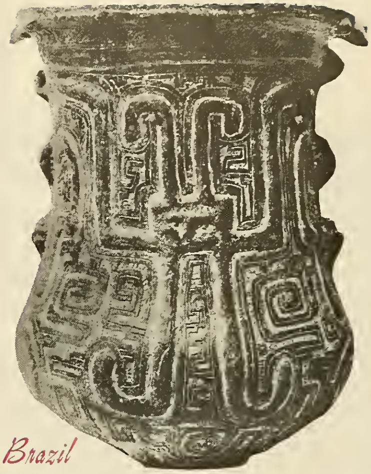
The importance of our questioning becomes more apparent if we examine the history of the early development of civilization in the Old World – in the Near East, Egypt, Europe, India, and China. The more we learn of these great cultural centers, the less it appears that they were separate civilizational developments. They all seem to have sprung from one cultural development occurring somewhere in the Near East, and their growth involved a certain amount of cultural interaction. Thus, despite their differences, they can be considered as one great cultural development.

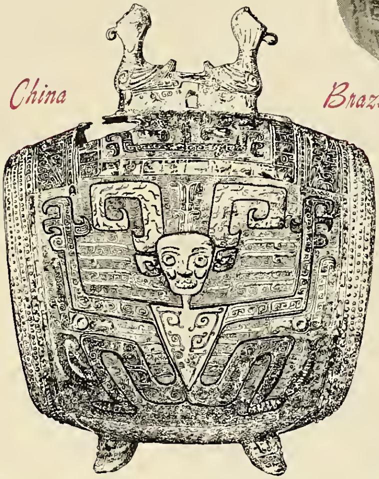
Are the higher civilizations of America the world's only exception, the one other example of this all-important rise from a stage of primitive culture to the complex form known as civilization? If they are an exception, there have been two isolated occurrences of civilizational growth in the history of human culture, and we come as close as we ever will to having a kind of laboratory check on how civilizations, as great units of cultural development, originate and grow. This would obviously be of extreme importance to all theoretical considerations of human history. If, on the other hand, the birth of the American civilizations can be traced back to influences coming out of eastern Asia, it is something we must know if we are to evaluate correctly the history of human culture.

To phrase the question in more concrete terms: Are certain cultural forms inevitable in the growth of civilization? Given enough time, would any large group of people living in a suitable environment rise from a hunting-gathering existence to one based on agriculture? In both southeast Asia and the Amazon area, blowguns are used with poisoned darts for the hunting of small game, and they are remarkably similar in constructional details and in decoration. Was the blowgun invented independently in those two areas, because of the existence of similar environmental conditions and the presence of suitable materials? Is the form in which one makes a stone club so much governed by its intended use that such specialized types as the star-shaped or "pineapple" clubs found in Melanesia and America would be invented again and again?

This problem of whether or not the American Indian cultures were influenced by those of the Old World has been argued since the time when Europeans first came to know the American Indian in the fifteenth and sixteenth centuries. As we shall see later, it is a problem difficult to prove definitely one way or the other. It is a field in which quite opposite opinions are sometimes held by persons equally well informed.

On the one hand, there are those who have been labeled *independent inventionists* — those who believe that the American Indian civilizations evolved by themselves in the New World without benefit of cultural promptings from the Old. This side of the argument has been upheld for the last three decades or

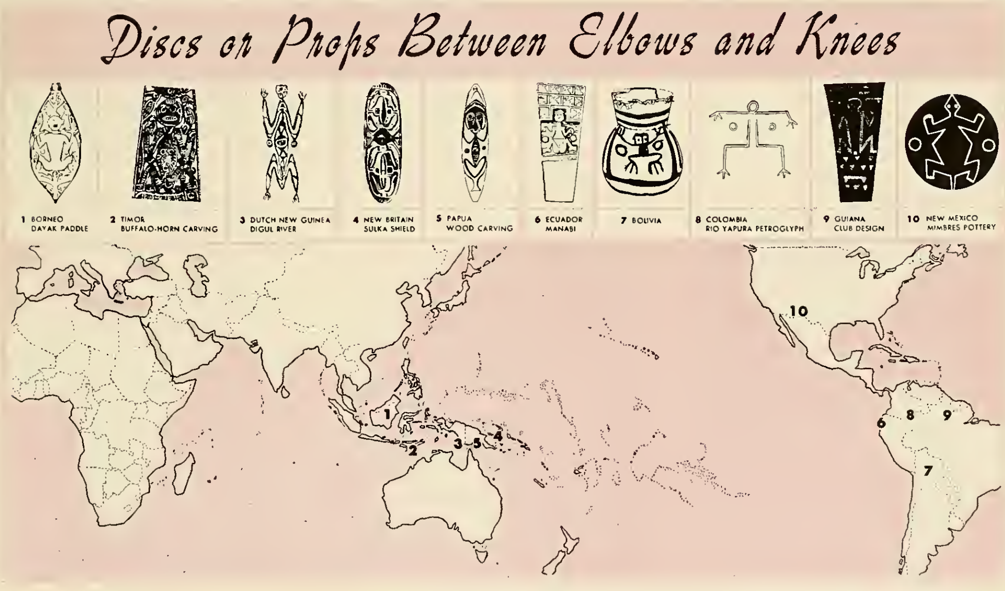




SIMILARITY OF DECORATION is shown in this bronze drum from the Shang period of ancient China and a jar from eastern Brazil. Grotesque arms, legs, and horns —stylized in the same way and superimposed upon a decorated background— characterize both pieces and hint at a common artistic tradition, though the regions are many thousands of miles apart

▼ ON BOTH SIDES of the Pacific discs or props are inserted between the elbows and the knees in conventionalized drawings of the human figure. The examples shown are a few out of the many that have been noted

From exhibit prepared by Dr. Carl Schuster


Discs or Props Between Elbows and Knees
1 BORNEO DAYAK PADDLE
2 TIMOR BUFFALO-HORN CARVING
3 DUTCH NEW GUINEA DIGUL RIVER
4 NEW BRITAIN SULKA SHIELD
5 PAPUA WOOD CARVING
6 ECUADOR MANABI
7 BOLIVIA
8 COLOMBIA RIO YAPURA PETROGLYPH
9 GUIANA CLUB DESIGN
10 NEW MEXICO MIMBRES POTTERY
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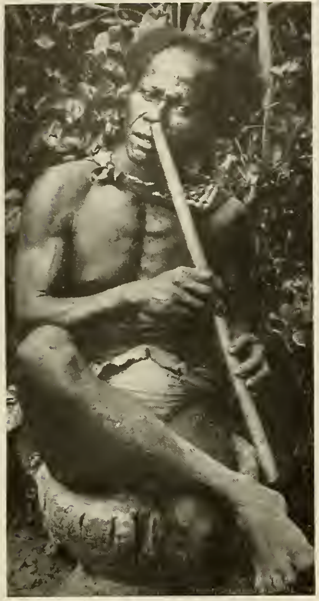
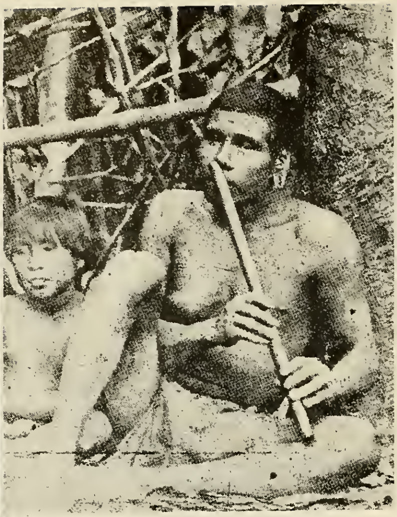
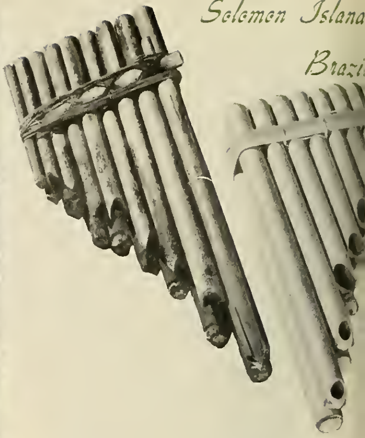
Music



Dean C. Worcester
© Courtesy National Geographic Magazine



NOSE FLUTES. The curious custom of blowing a specially made wind instrument with the nostril is found in the Philippines and South America. Being a trait common to simple cultures in the two areas, it might conceivably have spread from the Old to the New World with the original peopling of the Americas by the Bering Strait route. But students who are inclined to accept the theory of trans-Pacific traffic include this with the many other curious similarities



▲ PANPIPES provide one of the more convincing indications of trans-Pacific contact. They are found in Peru and many parts of the Old World. Pipes from as far apart as the Solomon Islands and Brazil have been found similar in pitch and scaling. Both of those shown have two rows of pipes, one closed and one open

more by a majority of the anthropologists working in the American field. The possibility that significant trans-Pacific contacts may have occurred has been almost totally discounted, and those who study anthropology in the United States are strongly indoctrinated with this point of view.

In contrast to those who would view the American civilizations as an independent growth are the so-called *diffusionists.* These would minimize the likelihood that the same things could have been invented more than once, and would explain the cultural parallels in the Western and Eastern Hemispheres as a result of historical contact. In recent years adherents to this point of view have not been numerous among professional anthropologists. Furthermore, among those who have espoused the cause and have thus flouted "authority," there are some who have seemed to find it necessary to take an extreme point of view, insisting that every cultural trait of any significance in the New World, if it appears similar in any degree to one in the Old, must have come by diffusion from the Old World. This has tended to weaken the argument rather than to strengthen it.

With an interest in bringing this problem more into the open and to stimulate serious discussion of it, the Department of Anthropology of the American Museum recently presented a special exhibit, which asked, in a visual manner, some significant questions about the possibility of Old World influences on the American Indian cultures. It was especially prepared for a meeting of the International Congress of Americanists being held at the Museum and was thus seen by an unusually large number of specialists concerned with the problems of American Indian origins. The interest shown by these experts and the lively debates that ensued were sufficient proof that our exhibit was dealing with an important problem.

The exhibit showed, side by side, objects and photographs of various things from Asia and Oceania on the one hand and America on the other, pointing out similarities that might be thought to indicate cultural relationships between the two areas. It asked the question: What do these parallels in the two areas mean? We do the same in a more limited way in the illustrations accompanying this article.

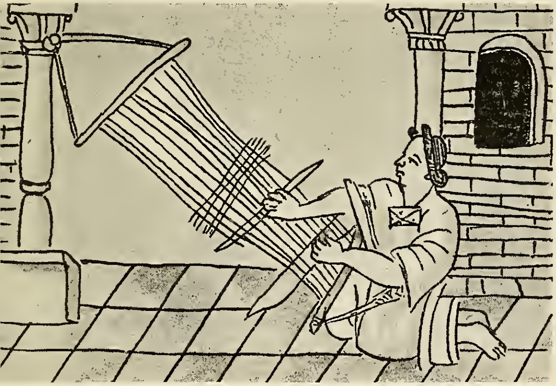
In attempting to trace historical relationships through the study of customs and material objects when no written records are available, some things must be considered more significant than others. It might reasonably be argued, for instance, that because of the limited number of possible ways that could be used to decorate woven textiles, the use of tie-dying might be invented again and again and its oc-

Textile Industry

Philippines

In both the Old and New World, the simple two-bar backstrap loom has several basic features in common, including the use of shed rods, heddles, and battens. Tie dyeing is common to southeast Asia and America, and so is the specialized decorative technique called *ikat*—a method wherein the yarn is dyed in such a way that a design will come out when the cloth is woven

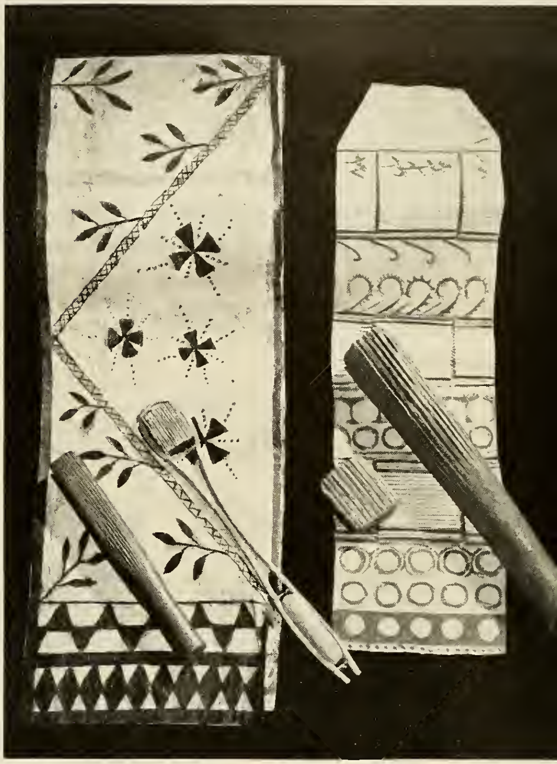
Mexico



Bark Cloth Manufacture

Oceania

Middle America

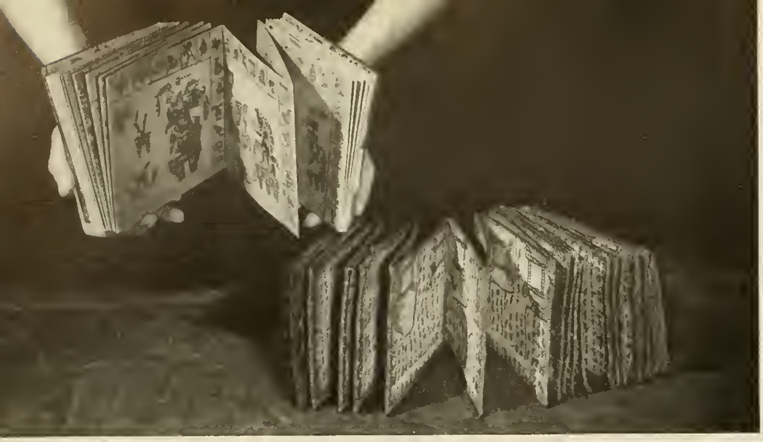


▲ The method of manufacture and the implements used are common to the Pacific area and tropical America. Outstandingly similar are the rectangular stone beaters from the Celebes and from Mexico, with corrugations on both sides and grooves around the edges for hafting. Are these identical tools and techniques the result of the same functional adaptations, or is historical relationship implied?

currence in two areas would not be an indication of historical relationship. But there is not the same limitation of possibility when it comes to decorative design. The possible combinations in naturalistic and geometric motifs make it exceedingly unlikely that the same combination will be invented repeatedly by groups having no contact. With this in mind, it is interesting to consider what we call the lotus motif as used in Buddhist art in India and southeast Asia and in certain Maya sculptures at Chichen Itzá in Yucatán. Because of a lack of space, full illustration of the comparable material cannot be given here, but the drawings we have included on page 345 may be sufficient to indicate some of the points of similarity.

In both areas the lotus plant has been used as the principal motif in the border portions of large relief-sculptured panels. In both cases the lotus plant has been given an undulating, creeper-like shape not corresponding to nature, and the buds, leaves, and full flowers are arranged within the pattern. Human figures are interspersed, holding on to the rhizome of the lotus plant in very much the same way, and fish or fishlike monsters are used at both ends of the panels. There are instances in both areas of the lotus emerging from the mouths of jawless monsters. Could this complex of motifs have been invented, or rather could it have evolved separately in the two areas without any contact between? To my mind it appears more probable that these similarities resulted from some historical contact between the two areas.

If these two occurrences of the lotus motif look sufficiently similar to stimulate one's interest in possible



Books

◀ Similar methods of bookmaking are shown in these two examples from Mexico and Sumatra. They are made of a continuous strip of material, used on both sides and mounted between board covers. Both are made of specially prepared bark; both are, in part at least, books of divination

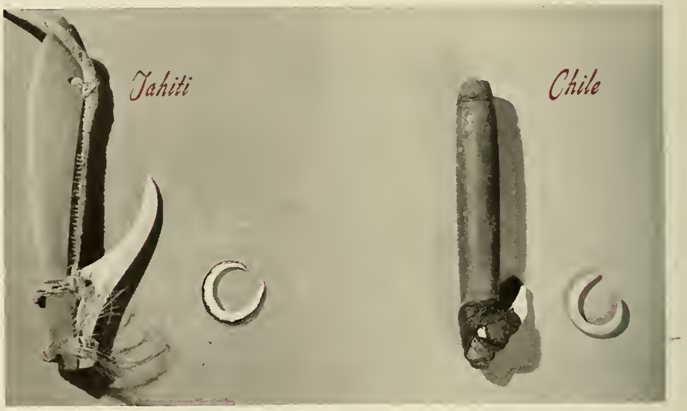
historical affiliations, let us look further for other similarities between the Buddhist art of India and southeast Asia and Maya art. In both areas a common religious-artistic conception portrays a dragon-like monster with wide-open jaws and with a human face or figure in the mouth. There is also the well-known "cross" at the Maya site of Palenque, having the form of a stylized tree with a grotesque face in its branches. This is markedly similar to the representation of the celestial tree on top of the cosmic mountain in the shadow-play figures of Java—a motif of considerable antiquity in southeast Asia. There are a number of other comparable motifs in the two areas, including the use of serpent balustrades, Atlantean figures, and gods or ceremonial figures standing on the backs of crouched

Implements

Easter Island

California

The distribution of certain forms of fishhooks provides striking evidence of possible communication across the broader reaches of the Pacific. These beautifully made stone fishhooks from Easter Island and California could hardly be more alike



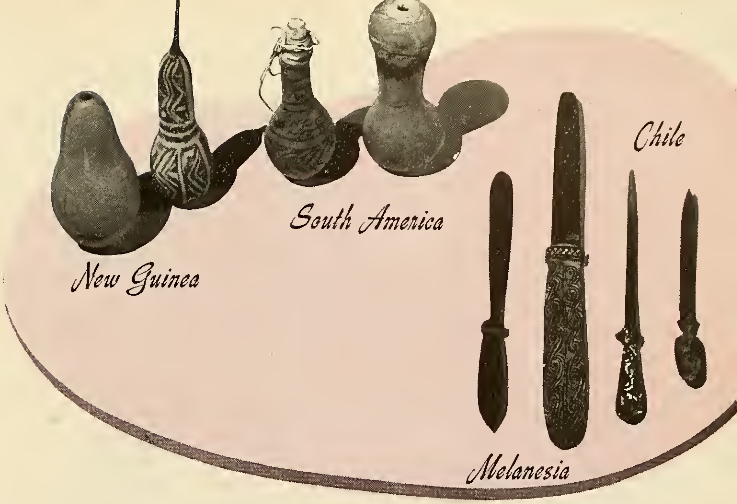
▲ Even more significant than the identical stone hooks are two other types found in combination on many islands of the Pacific and archaeologically in coastal Chile. In both regions, the larger composite hook is made of shell, bone, or stone, and the smaller one of shell

Wheeled Toys

The finding of wheeled toys made of clay in Mexico (*right*) shows that the principle of the wheel was understood by the Mexican Indians before the time of Columbus, even though wheeled vehicles were apparently not used in transport in the New World. Similar miniatures in bronze, sometimes representing gods, were also used in China and India (*left*)

Betel and Coca

➤ BETEL-CHEWING in southeast Asia and Melanesia has much in common with coca-chewing in the Andean region. In both localities lime is added to release the alkaloid. Certain accessories used show remarkable parallels, as seen in this photograph. Lime containers in both regions are frequently made of gourds of the same species. Two wooden spatulae from Chile are very much like their Melanesian counterparts.



human figures. One of the most striking parallels, however, is that seen in the game of pachisi as played in India and southeast Asia and of the game of patolli as played by the Aztec. In these two games there are a number of quite specifically similar features that make it exceedingly unlikely that they developed independently.

The parallels we have mentioned so far are probably more significant than many of the others shown in the illustrations because they represent a complex of traits that belong to specific cultural traditions and specific periods in both Asia and America – the Buddhist dominated cultures of India and southeast Asia of from the second to the twelfth centuries and the Maya-Mexican cultures of the New World running from approximately A.D. 500 to 1200. In regard to these, we are not subject to the criticism often directed toward those who have attempted to link the Old and New World cultures—that scattered traits from here and there have been compared and no logical scheme of possible relationship has been given. In showing a number of similarities to exist between Buddhist art and Maya-Mexican art, we have outlined a specific area of study that can be attacked and discussed in a scientific way.

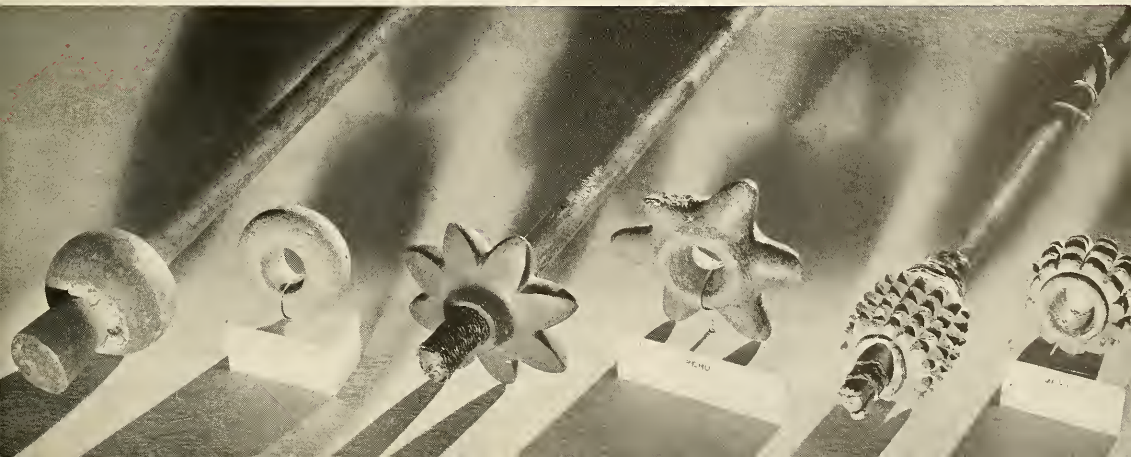
The whole problem of Old and New World relationships is, of course, so complex that we cannot begin to discuss it in any detail in a short article. We must mention, however, that recent studies of American cultivated plants have suggested the possibility that maize, or corn, the basic American food plant, may have been cultivated in upper India and Burma before the time of Columbus and transported in one direction or the other across the Pacific.

If we feel that these parallels between the civilizations of the Old and New Worlds indicate historical relationship, we find ourselves faced with the not inconsiderable problem of explaining how contacts between the two areas came about. What sort of contacts could have taken place across the very broad reaches of the Pacific? It is largely the difficulties involved in finding an answer

Continued on page 382

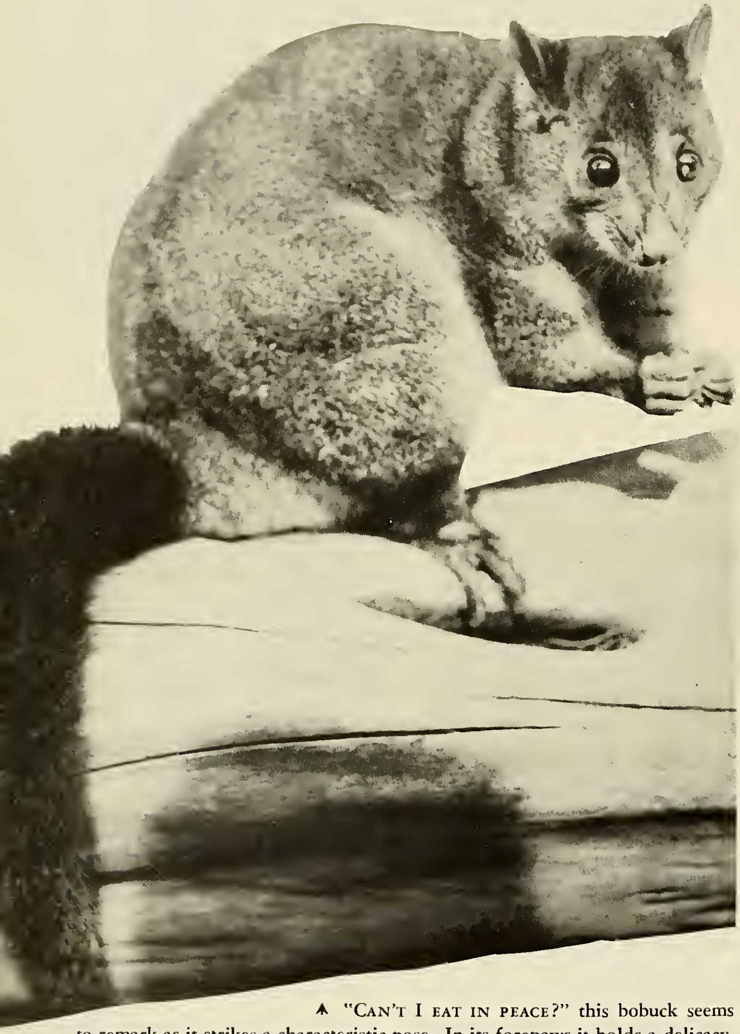
Weapons

⮟ STRIKING LIKENESSES are seen in the stone tools of Asia and Oceania on the one hand and the Americas on the other. The clubs with handles are from Melanesia, in the southwest Pacific; those without are from Peru and Mexico. Diffusionists argue that nearly identical forms like these could scarcely have evolved independently. Their opponents invoke the long arm of coincidence and point out the many *dis*similarities between the oriental and American Indian cultures



Meet Australia's bobuck—a rare and remarkable animal whose splendid pelt is its worst enemy

POSSUM of the HIGH RANGES



▲ "CAN'T I EAT IN PEACE?" this bobuck seems to remark as it strikes a characteristic pose. In its forepaws it holds a delicacy, which it chews happily despite the daylight

By DAVID FLEAY*

All photographs by the author

IN the dense mountain timber fringing eastern Australia from south Queensland to southern Victoria lives the mainland's largest, most powerful, and finest possum. It is, in fact, the equal of the famous long-furred Tasmanian "Black." Usually referred to as the short-eared possum—an obvious distinction from the rather fox-faced silver-gray or brush-tail possum—this black-footed marsupial is also known by the aliases of mountain and dog-eared possum.

It is a remarkable, distinctive, and very alert animal, noted for a peculiarly rank and musky odor that is almost as easily detected in the bush as the powerful scent of fox. In the region of Gippsland in eastern Victoria this magnificently coated species (*Trichosurus caninus*) has the nickname of "bobuck"; and wearing the most prized of pelts it became, in open seasons, the trapper's most sought-after quarry. Sad to say, this striking marsupial took the brunt of destruction in the dreadful sweep of the 1939 bush fires, and only recently have I seen odd individuals in regrown areas that were formerly their strongholds.

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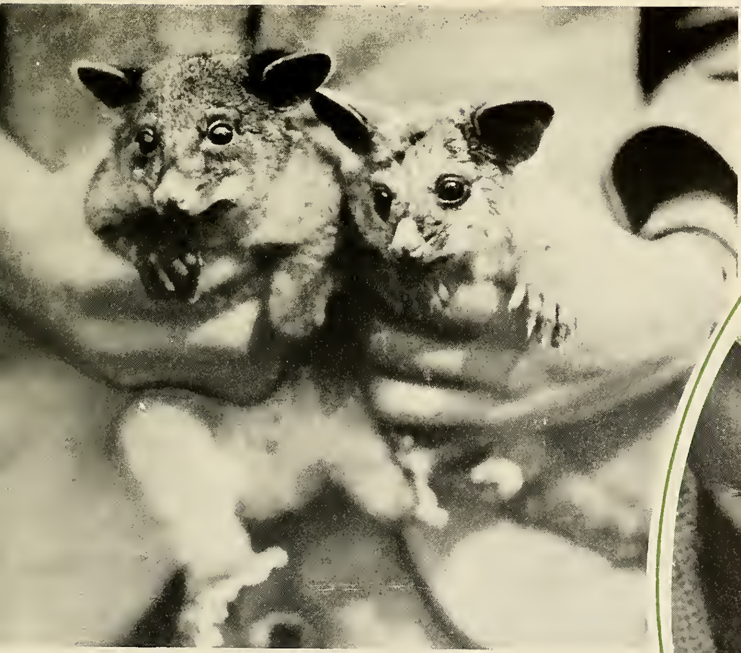
*DAVID H. FLEAY, an expert on the fauna of his native Australia, has approached his specialty from every angle: research, teaching, writing, and field work. He was the designer, builder, and curator of the Australian Section of the Melbourne Zoo and later director of the Sir Colin Mackenzie Fauna Sanctuary. In 1941, he was awarded the Australian Natural History Medallion.

Mr. Fleay is the only man who has succeeded in breeding the platypus in captivity; and it was he who captured, conditioned, and transported Cecil and Penelope, the platypus couple, to the New York Zoological Society in 1947. He is the author of two books, *We Breed the Platypus* and *Gliders of the Gum Trees*, and is a Council Member of the Royal Zoological and Acclimatization Society of Victoria. He has contributed to a number of periodicals.—ED.

Typically a slow breeder and a creature of peculiar surroundings, this mammal has been unable to adapt itself to the great variety of foods and environments enjoyed by the common silver-gray (*T. vulpecula*). The bobuck is a mountain fellow and is essentially at home in the elevated, high-rainfall regions of mountain ash (*Eucalyptus regnans* and *E. gigantea*), beech, hazel, sassafras, dogwood, musk, and tree fern. This big possum, with its extremely bushy and almost wholly black tail, is usually dark gray in color. But from the scrubs of northern New South Wales and southern Queensland, a truly black race has been described, and odd velvety-black individuals have also revealed themselves in the Healesville-Warburton ranges.

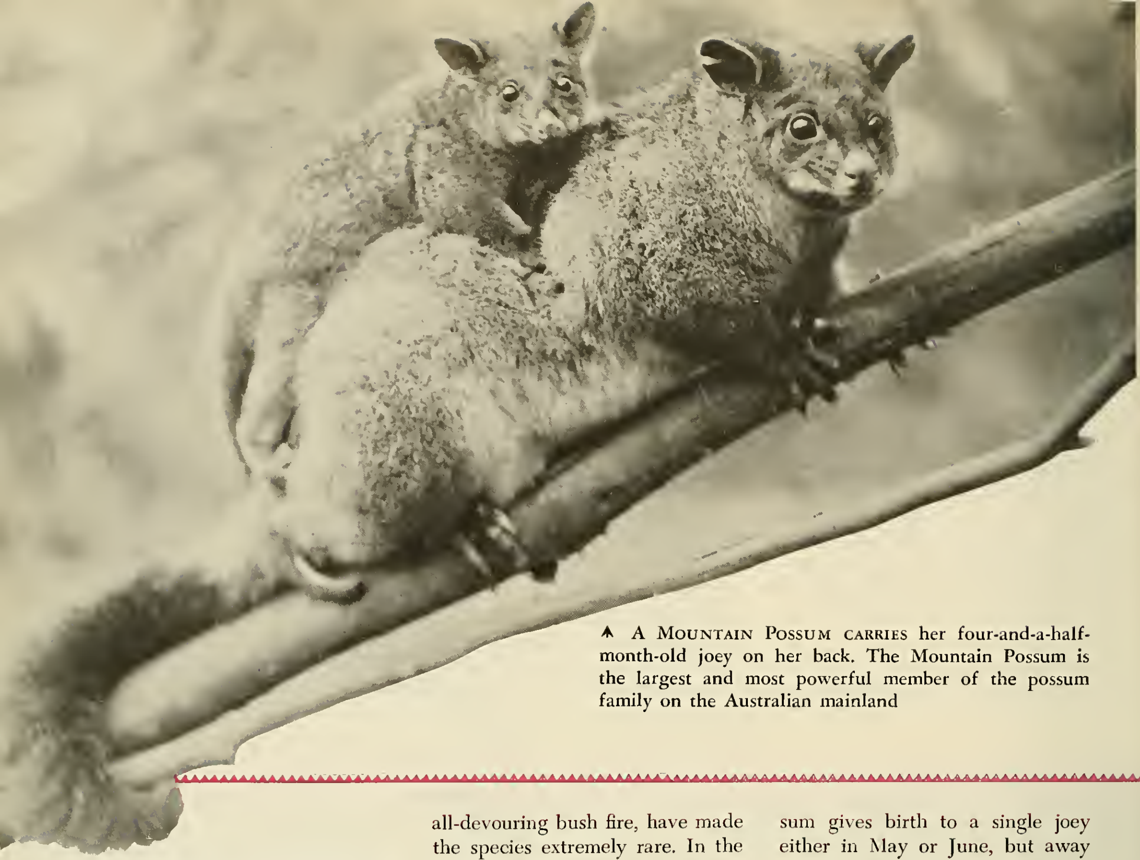
By night the big fellows wander the gullies, spending practically the whole of their time on the ground feeding upon succulent shoots and young leaves, fern fronds, flowers, and fruits. Following faint trails, they bound along handy bridgeways of huge fallen trees that span crushed and impenetrable masses of tangled vegetation. Seldom, indeed, does the bobuck ramble to a great extent in the trees, though it readily scampers aloft when danger threatens. The large sturdy feet are obviously more those of a ground wanderer than are the comparatively slender ones of its relative, the silver-gray. However, when actually treed by the sight or scent of intruders, the bobuck trumpets defiance in a series of loud and rapid staccato grunts that are quite unlike any other bush sound. Entirely distinct from the blare and chuckle of the silver-gray, this call is unmistakably characteristic of this species alone. At close quarters, the animals not only utter defiant grunts but raise themselves to full height with arms drawn back in sparring position ready to strike, at the same time adding "circular saw" screams for good measure. This is by no means pure bluff; incautious handling of the animal proves it a formidable antagonist, equally handy with its ripping claws and biting teeth. W. A. Wheelwright, the old bushman-author-game shooter of the 1850's, recorded very graphically the possum's habit of escaping the reach of an enemy, ". . . at which it will sit swearing after the manner of a cat."

In hours of darkness, the bobuck's forthright call may be heard occasionally from an enclosure in Healesville Sanctuary, where a fine eleven-pound specimen, originally bred there, now has a snug home in a hollow log. Recently, while spending some days and nights in the bush investigating lyrebirds, pleasant memories of other days were recalled when the insistent trumpeting of a wild bobuck in a near-by mountain ash proclaimed its dislike



▲ TWO JOEYS of different species: short-eared possum (*left*) and silvery-gray possum (*right*). Both are four and a half months old, but notice the difference in size

▼ A FOUR-WEEK-OLD POSSUM, naked and helpless, fumbles outside the mother's pouch. It is still strongly attached to the mammary gland. It does not become independent of the parent until it is six months old



▲ A MOUNTAIN POSSUM CARRIES her four-and-a-half-month-old joey on her back. The Mountain Possum is the largest and most powerful member of the possum family on the Australian mainland

of our hurricane lamplight. Sad memories were also recalled, for it was along the Acheron River in late 1938 that we undertook to capture the original mountain possums that graced the Sanctuary for so many years. Here Harry Kerslake and his wife and daughter watched the traps until success attended their efforts. When the great fire of '39 overwhelmed that beautiful valley and most of its fauna, it was the Kerslakes who so tragically perished in their ill-fated dash down the Acheron Way.

In past open seasons the mountain possum has been hunted unrelentingly for its thick and beautiful pelt. One of the natural baits used to attract the animals into snares and "figure-of-four" traps is a portion of the crown of a split tree-fern trunk—an irresistible delicacy to mountain possums. Unfortunately, the animal is not a rapid and hardy breeder, and in many mountain districts former trapping operations, plus the ravages of the all-devouring bush fire, have made the species extremely rare. In the event of a declaration of open season for possums in the future, it is earnestly to be hoped that the short-eared species will remain totally protected.

Though retiring and nervous in disposition, the bobuck has an appetite for delicacies that soon conquers its timidity. One night in a gully in the Dandenong Ranges the crackling of sticks among the damp tangle of blanket wood, sassafras, wattle, and hazel betrayed the movements of one of these big possums. I trailed it, but it suspiciously ran up a sapling and perched on a limb about seven feet from the ground. Leaping up, I seized the tip of its great bushy tail and brought the animal down. The bush rang with its ear-splitting shrieks; but less than four minutes later the same disheveled marsupial was squatting in a box, still snorting defiance but at the same time devouring a ripe pear with great relish and noisy chewing.

In Victoria the short-eared possum gives birth to a single joey either in May or June, but away from native foods it is not easy to induce the species to breed in captivity. The pouch of the female contains two mammae, but unlike the silver-gray, which occasionally rears twins, there are no records of more than a single youngster occupying the pouch at a time. Before the birth, the female constantly examines and licks out her pouch, and as soon as her pink, ugly mite arrives (only three-eighths of an inch long at birth!), it instinctively works its way into the pouch. In the case of the silver-gray possum, I have taken newborn young out of the pouch and have watched them re-perform this wonderful feat.

At birth the infant is not only minute but blind, with stunted, undeveloped limbs. For six weeks, it is firmly attached in the pouch, gradually developing power to move its own small jaws. It is most interesting to watch the mother's antics at night, as she pauses in her ambling walks to sit up on her haunches, relax the muscular, ringlike pouch-opening, and, holding it agape with handlike forepaws, thoroughly cleanse the small occupant with her tongue. At the age of about ten weeks, short fur appears first on the head and with time gradually spreads to the shoulders and lower body. At four months the young one, now about guinea-pig size, forsakes the pouch and rides at night on its mother's back, clinging tenaciously with claws and teeth. For some weeks longer, it continues to draw nourishment from within the pouch but also chews tender shoots that come within its reach.

If separated from its mother for even the briefest time, the joey soon attracts her attention with an urgent series of quavering, husky cries. "Roger," a baby mountain possum born and reared in my collection, usually rode on Ma's back to the food basin in the evening but always conveniently slid over her head to the honey, jam, and bread when she reached her destination. Not until it is six months old does the short-eared possum become independent of its faithful parent.

Present on the chest of mountain possums, as on the silver-gray, is a longitudinal streak of rust-colored fur in the otherwise creamy-white "vest." This is a glandular area; and, remarkable to relate, massage of the chest of one species of kangaroo has been known to produce a reddish pigment. Mountain possums, however, are in the habit of rubbing this area on convenient boughs, performing quite a ritual in the process. The next short-eared fellow to come along scents the spot, and with the obvious attitude of "So-and-So has passed this way," he, too, rubs his chest on the limb or bough. So much for self-expression among the nocturnal denizens of the big timber!

Though home trees of the species may usually be detected by the deep scoring of the bark, torn from the ground up by constant passage of strong claws, the animals do not always sleep aloft. They frequently camp in cavities created by termites and by rot inside great fallen logs. No attempt is made to line the resting place with materials of any kind; the animal simply squats, rolled up, on the bare wood. The musky odor, particularly strong in the "old men," is usually sufficient to determine whether the tenant of a hollow is at home.

▲ Setting a snare in a deep tree-fern gully in mountain-possum country. The tree ferns range from one to forty feet in height. At this spot a stream dives twenty feet below the surface and emerges farther down. The bobuck thrives only in elevated, forest regions such as this

Spring, summer, autumn, and cold winter sojourns in mountain country on the trail of rare marsupials have brought us a variety of contacts, accidental and otherwise, with short-eared possums. Far up the slopes of Mt. Wills, northeastern Victoria, a trumpeting overhead awakened us at 2 A. M. one black night, and the spotlight beam revealed the blazing red orbs of a huge, thick-furred fellow perched on a thin sapling. Two strokes of the ax and he was down in a wild scatter of provisions and equipment. The ensuing chase flashed through and around camp, up and down blanket wood and dogwood bushes, until eventually "possie," minus patches of easily lost fur, was escorted back under guard, as breathless (though not as cheerful) as the gang that celebrated by "putting the billy on." I have met and carried several bobucks for miles out of the bush at Upper Beaconsfield, Bendock, Mt. Cole, Bonang, Korweingeboora, the Snowy River country, and nearer home at Healesville. I recall mountain possum in the brightness of morning daylight gazing reproachfully at us as they sat tethered in snares set for other game.

Perhaps the greatest anticlimax to an otherwise easy capture occurred on the Black Spur roadside one midnight in the 1930's. A bobuck had scampered off the road and bolted up a young ash; and as I followed, weakening fast and mighty breathless, up the branchless 20-foot trunk, that usually very thoughtful lady, my wife, suddenly emerged from the car shrieking, "Not in those good trousers!" Laughter was fatal, and I fell down helpless. What a time to tackle a man about the relatively unimportant subject of clothes!

A five-year-old boy was murdered on March 27 in Sarasota, Florida. Perhaps "murder" is not the right word, for Edward Schooley was killed by a circus elephant. "Dolly" had been one of the most docile members of the Ringling Brothers, Barnum and Bailey elephant herd for more than twenty years. But for some inexplicable reason she suddenly turned vicious and trampled to death the child who was offering her a peanut. The president of the circus publicly announced that Dolly would be destroyed, and this was done within three days after the tragedy.

According to radio reports, circus officials received many letters and telegrams from people all over the country complaining that Dolly's execution was unjustified. They apparently felt that a moral issue was involved and that an animal could not be held responsible for its actions. This point of view implies some interesting assumptions concerning animal psychology, but one thing is quite clear. If such an event had happened one or two centuries ago, the animal involved would have received quite different treatment. The law today states merely that dangerous or vicious animals must be destroyed. This represents a fairly recent simplification of older legal codes.

Ancient Hebraic law decreed that the goring ox be stoned to death. Plato's "Laws" directed that if any animal killed a man, except in combat authorized by the State, the nearest kinsman of the victim should prosecute the murderer. The case was tried by a public official, and if the verdict was against the accused, the guilty animal was banished from Greece. Citizens of Rome used to celebrate the anniversary of the preservation of the capitol from night attack by the Gauls. On this occasion homage was paid to descendants of the sacred geese whose cries had given warning of the enemy's approach. On the same day a dog was crucified for the failure of its forefathers to give the alarm.

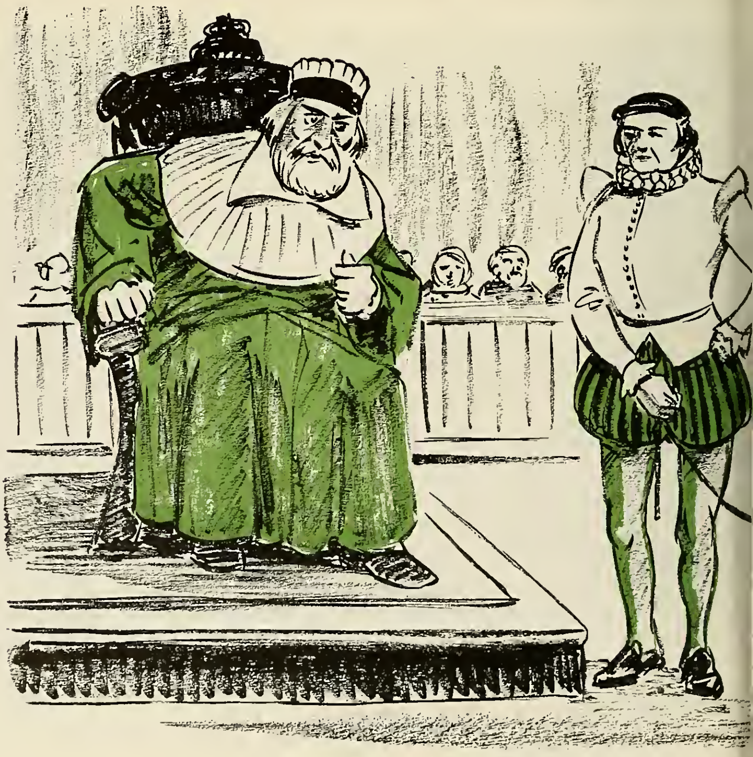
During the Middle Ages the practice of trying and condemning animals was common in Europe and the British Isles and later even in the New World. It was not confined to small villages and backward regions. In 1546 the French Parliament, the highest court in the land, ordered the execution of a cow, which was first hanged and then burned at the stake. Similar legal trials survived until fairly recent times. In 1906 in a small Swiss village a man and his son, accompanied by their dog, robbed a householder, and in the course of the crime the victim was killed. The two men were sentenced to life terms; but the dog was condemned to death because, the court decreed, it was the chief culprit, without whose complicity the crime would have been impossible.

Between A.D. 824 and 1845, there were at least 144 formal prosecutions resulting in the execution or excommunication of animal criminals. When a domesticated animal injured or killed a human being, it was formally arrested and thrown into jail. Then the judge or ruling nobleman of the district appointed one or several attorneys, who were charged with the duty of defending the accused. Public prosecutors and defense lawyers argued each case before the bar, and the evidence was weighed carefully by the judge before he rendered his verdict.

Mass indictments were not uncommon. On September 5, 1379, the village swineherd of Saint-Marcelle-Jenssey left the communal herd in the care of his son. Before his father was out of sight, the boy began to tease some nursling piglets, which promptly burst into

Beasts

▼ THE HIGHEST FRENCH COURT tried a cow in 1546. On the assumption that animals possessed a moral sense, capital punishment was the verdict

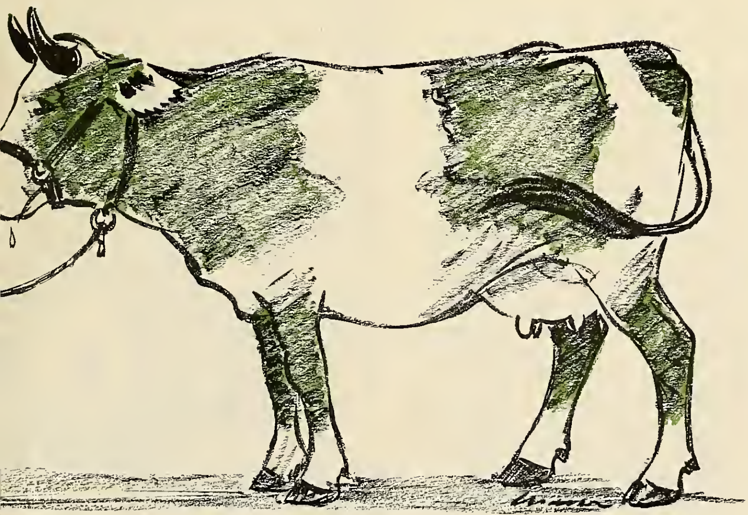


Before the Bar

Quaint court scenes of yesteryear show that ignorance of the law was once no excuse even for an animal

By Frank A. Beach

Department of Psychology, Yale University



a cacophony of terrified squeals. Three old sows charged the tormentor, knocked him to the ground, and killed him before his father could intervene. All the pigs were hurried off to jail, and after due process of law, Philip the Bold, Duke of Burgundy, condemned the three murderers to death. Their guilt was so plain that no one protested the decision, but the legal position of the remaining animals was less clear. The prosecutor insisted that they should be punished as accomplices. He called several witnesses, who testified that all of the swine had hastened to the scene of the murder and shown by their gruntings and aggressive actions that they thoroughly approved of the assault. A wholesale execution was narrowly averted when the attorney for the defense pointed out that the punishment of the convicted pigs would doubtless serve as an effective object-lesson to the other swine and would deter them from committing any more offenses against men. The Duke found this argument convincing; and when the three murderers went to the gallows, the rest received a severe warning and were then released.

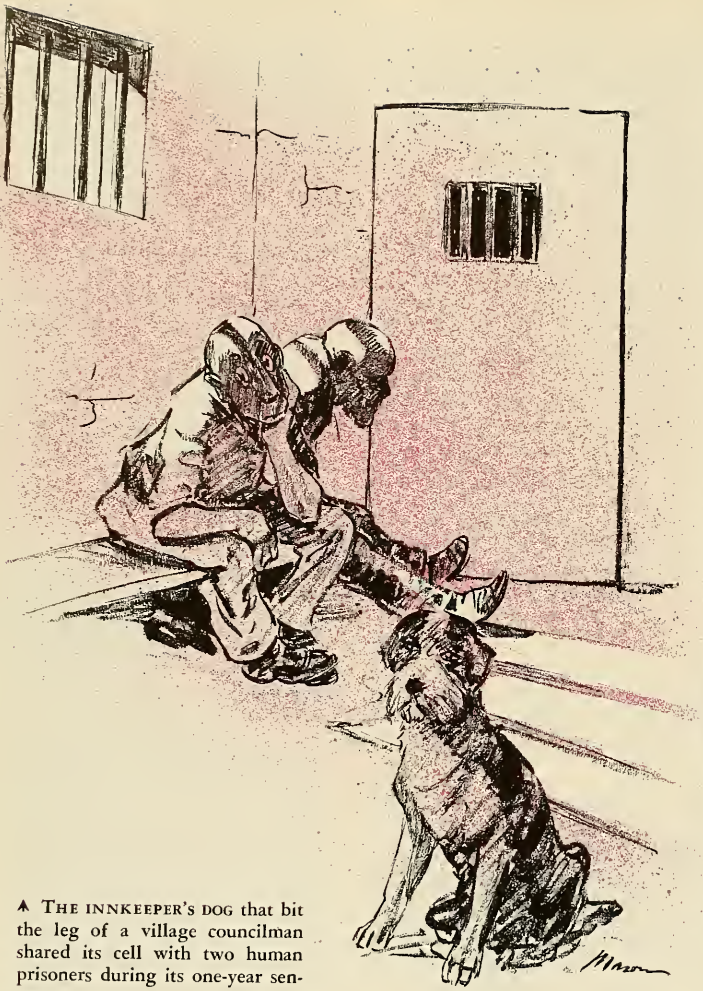
It was commonly assumed that lower animals possess a moral sense and could reasonably be expected to understand and obey man-made laws. But there were some jurists who held that the animal's owner was at least partially responsible for its actions. On January 10, 1457, a sow was convicted of "murder flagrantly committed" and was sentenced to be hanged. Her six sucklings were originally included in the indictment as accomplices. Positive proof was lacking, however, and they were released to their owner after he had furnished bail for their reappearance in the event that new evidence was uncovered. The man apparently believed in the inheritance of criminal tendencies, because after worrying about the matter for three weeks, he brought the piglets back to court, openly repudiated them, and refused to be answerable for their conduct in the future.

Swine were not the only animals guilty of criminal offenses. Cattle and horses occasionally ran afoul of the law and received precisely the same treatment as human criminals. Not only was the court procedure the same in each type of case; the same methods of execution were employed. The more common forms of capital punishment were hanging, beheading, or burning at the stake. Whenever possible, the animals were dressed in human clothes before the sentence was carried out.

Homicide was not the only crime for which animals were tried and punished. Jail sentences ranging from a few weeks to several years were not uncommon in cases of the willful injury of a human being by dogs, horses, cows, or other animals. In one Russian village a "he-goat" butted an important official while he was fastening his shoe, and as punishment the goat was banished to Siberia.

A German innkeeper's dog showed such poor judgment as to bite the leg of a village councilman. The animal's master was jailed at once, but he complained so vigorously against this miscarriage of justice that the judge ordered his release. After all, the innkeeper argued, why should he languish behind bars while the real culprit went free? Appreciating the logic of this approach, the court arranged for the incarceration of the dog for a period of one year. The sentence was duly served, and the animal shared its cell with two human prisoners.

Medieval methods of dealing with *wild* animals were, of necessity, more complicated. It was often



▲ **The innkeeper's dog** that bit the leg of a village councilman shared its cell with two human prisoners during its one-year sentence

impossible to capture and keep in jail the untamed creatures that sometimes brought harm to men. Nevertheless, the death sentence was occasionally imposed. In 864, the Council of Worms decreed death by suffocation to a swarm of wild bees that had stung a citizen to death. When animal culprits were not available for physical retribution, action of a different sort was possible. Insects and other pests that indirectly harmed a man by destroying his property could, with appropriate assistance from the clergy, be excommunicated. This extreme measure was not usually resorted to until milder alternatives had been exhausted.

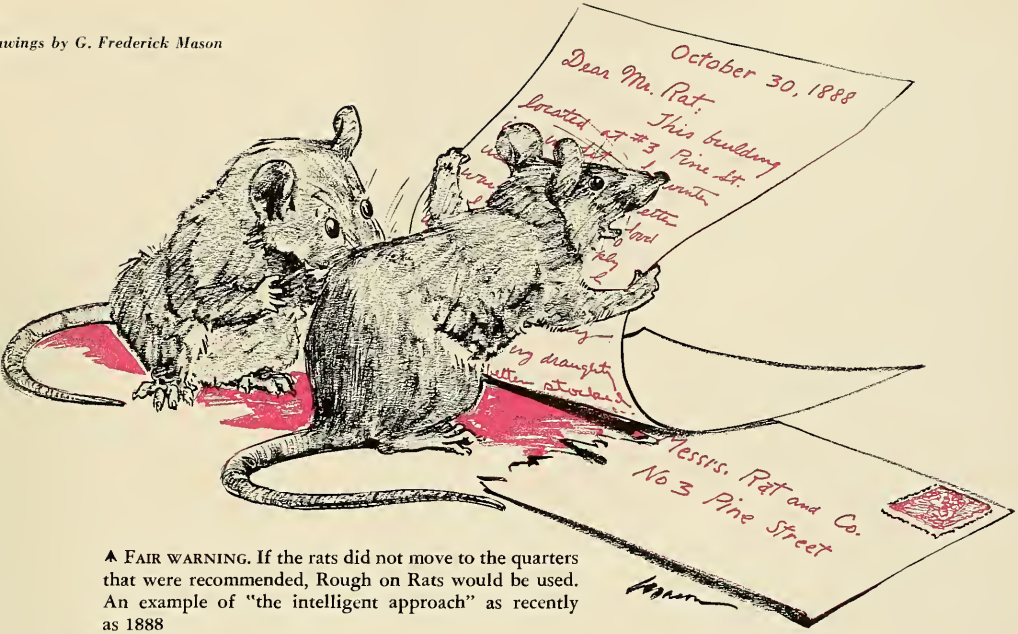
It was customary for example, to implore a swarm of locusts or a colony of rats to depart and cease whatever depredations they may have been committing. In some cases formal provisions for sanctuary were arranged, and the animals were notified by a Crier that they could take and maintain possession of a particular plot of land which had been set aside for their use. Usually the threat of excommunication was employed in an attempt to force the undesirable visitors to move away.

After the Middle Ages the Church grew less willing to participate in such animistic rituals as the excommunication of animals, but laymen continued to rely upon the efficacy of direct appeal to the presumed intellectual and emotional natures of lower animals. Sometimes the approach was informal and persuasive. In an old issue of the *Journal of American Folk Lore* there appears a copy of a letter dated October 30, 1888. It is addressed very correctly to "Messrs. Rat and Co." The writer begins with fervent expressions of his esteem for the rats and mentions his fear that they must find their present quarters at No. 3, Pine Street quite unsuitable for winter occupancy. He points out that the building was intended only as a summer residence and therefore is draughty and poorly supplied with food. By fortunate coincidence there is at No. 36, Sea Avenue a large, well-built house where the rats "can live snug and happy." The cellar is well stocked and a near-by barn contains large stores of grain. (Directions for reaching the address are included.) Having thus demonstrated his good intentions, the author of the published letter politely suggests that the rats take advantage of his well-meant advice. If they fail to do so, the letter concludes, "the undersigned, who owns the property at No. 3, Pine St., will be forced to use Rough on Rats."

The ethical propriety of adjuring the vermin to move to a neighbor's house seems not to have concerned this gentleman. At that, he was only

▼ **A provision** of the sentence was that the accomplices be warned of the punishment meted out to their more belligerent associates

Drawings by G. Frederick Mason



▲ FAIR WARNING. If the rats did not move to the quarters that were recommended, Rough on Rats would be used. An example of "the intelligent approach" as recently as 1888

repeating, with minor modifications, the medieval offer of sanctuary. The more attractive the new abode, the better the chances of acceptance. Peasants in some parts of Europe followed a similar practice in attempting to get rid of cabbage worms. It was customary to go out into the garden and invite the worms to depart, calling out, "In yonder village is church-ale." Church-ale signified a festival which, the peasants must have assumed, no lively cabbage worm could possibly resist.

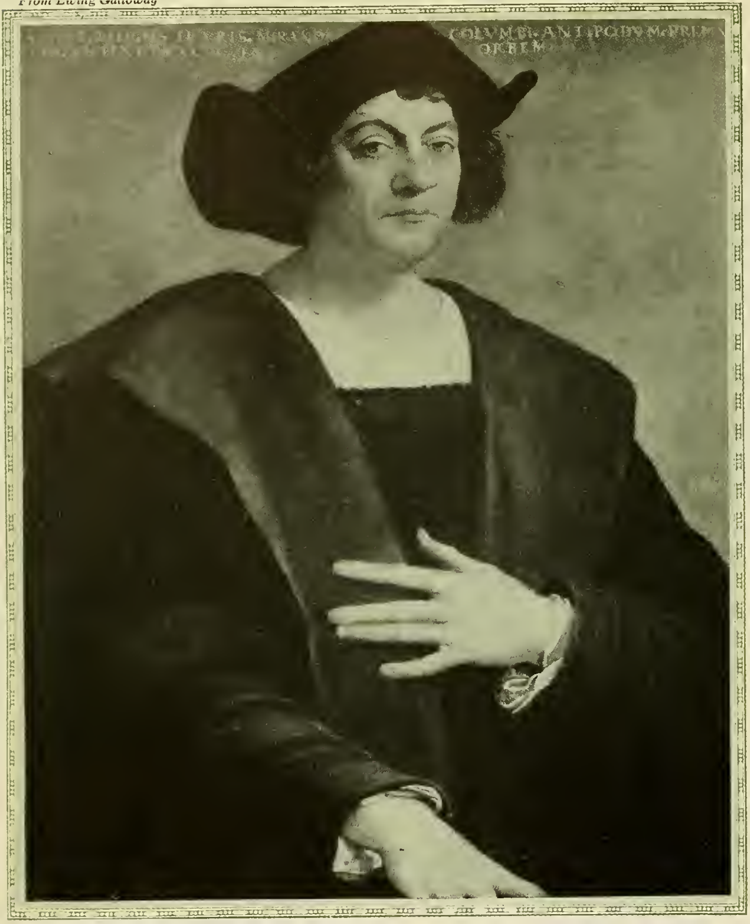
These historical accounts illustrate the universal human tendency to recognize certain similarities between ourselves and lower animals. In scientific jargon the tendency is termed anthropomorphism. It rests upon an implicit belief that other living creatures have the same kinds of psychological experiences as men and women. Probably many of the people who protested the killing of the circus elephant, Dolly, rationalized their objections by thinking of the precipitating event as an "accident." They may have felt that the animal did not "mean" to injure the boy. Regardless of their reasoning, these individuals were reacting precisely as human beings have reacted for many centuries.

Basic human attitudes and beliefs do not change rapidly. The notions that permitted our forefathers to try, convict, and execute animals as though they were criminals are not completely lacking from our own psychology in this modern and supposedly scientific age.

The difference is that our ancestors assumed that animals had a moral sense and that they either lived up to it or not. If an animal was guilty, it must be punished according to the same laws that applied to man. Today, we know a great deal more about the psychology of animals than our ancestors did and are in a position to know much better how a given animal should be treated. We should ask whether the offender is naturally vicious or whether it was goaded to violence by somebody's cruelty or carelessness.

The emphasis today is on proper precautions and laws to ensure public safety. Society demands that a dangerous animal be put where it can do no harm; but it also demands that the animal be treated humanely.

From Ewing Galloway



◄ THERE ARE many pictures of Columbus, but few seem to portray the same man. This one, in the Metropolitan Museum of Art, was painted by the contemporary artist Sebastian del Piombo

The Signs

On the 500th Anniversary of the birth of Columbus, a modern scientist retraces the momentous voyage and shows how much the famous navigator depended on his natural history information—and misinformation

By N. J. BERRILL

McGill University

COLUMBUS first saw the light of day 500 years ago, in the middle year of the fifteenth century.[°] Forty-two years later he saw another light, as strange and puzzling as the first. And because he himself was the first to see it, and because the landfall came only a few hours later, Columbus in person was credited with the actual sighting of land.

For days Columbus had been sailing on a westerly course that trended to the southwest, and expectation of a landfall was already running high. Late in the day of October 7 great numbers of birds were seen flying toward the southwest, and with the thought that they were going to sleep on land, Columbus changed his course from west to west-southwest. Land birds were seen all the next day, and birds were heard passing throughout the night of the ninth. Land seemed to be close, and hearts were uplifted. "Thanks be to God," said Columbus, "the air is very soft like April at Seville; and it is a pleasure to be here, so balmy are the breezes."

The "Nina," the fastest ship of the three, was already pushing forward, hoping to enjoy the handsome reward the Sovereigns had promised, and the Admiral had ordered that whoever should sight land first should hoist a flag at the masthead and fire a gun. At two hours after midnight on October 12, Rodrigo de Triano, a sailor on the "Pinta," saw the island in the moonlight.

This was the landfall, but what of the light? Columbus had been alone on the castle of the poop earlier that night, at ten o'clock—long after dusk and before the moon had risen. In the darkness of the night on the edge of the tropics, he saw a light and called to his companions. They saw it several times, and it was compared to a wax candle flame rising and falling. Columbus himself thought it was a sign of land, but no more than that; and decision that the light was actually on land—the decision that gave Columbus the award and later sent Rodrigo a disgusted renegade to Africa—was made virtually by default. No other explanation of the light was forthcoming.

The first sight of land was in the light of the moon and at a distance of six miles. Land as low-lying as these islands, seen from ships as small as the "Santa Maria," would seem to lie pretty well on the horizon at that distance and could hardly be seen much farther away. The light had been seen 4 hours earlier; and at the speed recorded at

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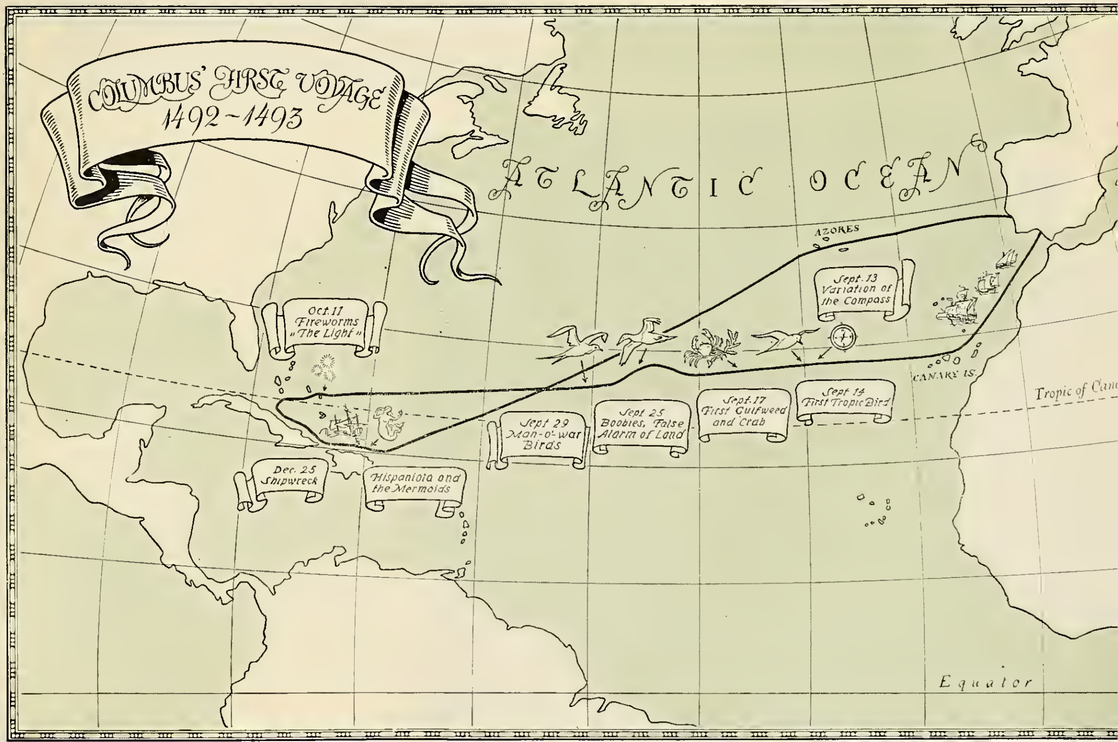
[°] Estimates range from 1446 to 1451.

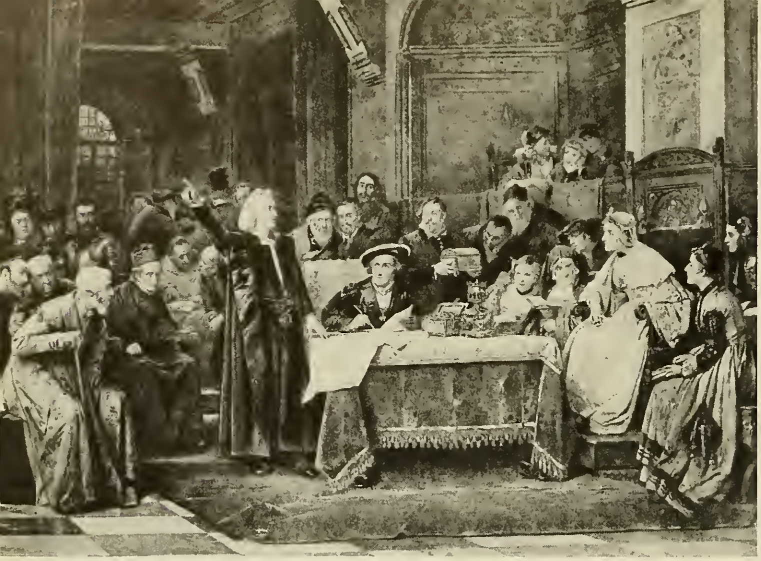
"Santa Maria"

MODELS of the three ships used by Columbus on his first voyage to the New World

from Brown Brothers

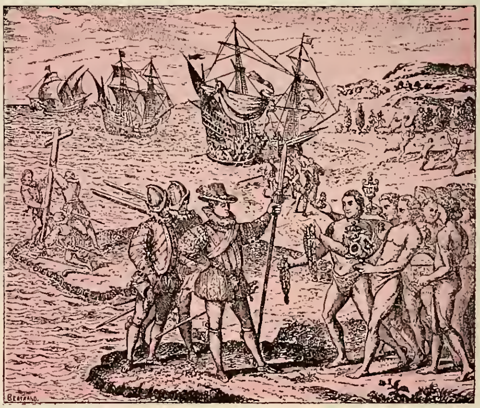
olumbus Followed


COLUMBUS' FIRST VOYAGE
1492~1493
ATLANTIC OCEAN
AZORES
Sept. 13 Variation of the Compass
Oct. 11 Fireworms "The Light"
CANARY IS.
Tropic of Can
Sept. 14 First Tropic Bird
Sept. 17 First Gulfweed and Crab
Sept. 25 Boobies, False Alarm of Land
Sept 29 Man-o'-war Birds
Dec. 25 Shipwreck
Hispaniola and the Mermaids
Equator



From Ewing Galloway

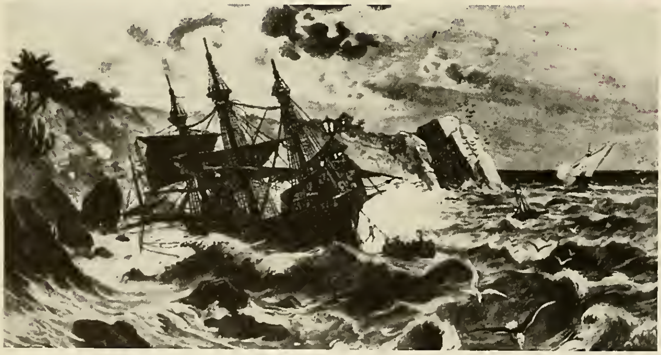
▲ A PAINTING depicting Columbus before Queen Isabella, succeeding after years of effort to secure assistance for his voyage to China and the Indies. Neither dreamed that a whole new world would be discovered. Had Isabelle known he would not reach the Orient, his voyage might not have taken place



The Bettmann Archive

➤ AN IMAGINATIVE PORTRAYAL of Columbus' first landing in the New World. Natural history signs recorded by the explorer now indicate that this spot was on Cat Island rather than San Salvador

▼ THE WRECK of the caravel "Santa Maria" on the coast of Hispaniola on Christmas Day, 1492. Engraving after Adolph Closs



The Bettmann Archive

the time, 35 to 45 miles had been traversed in the interval. So the light could not have been on the island that became San Salvador.

The question of the light has worried many people. An unexplained mystery bothers a man like an unfinished sentence, and the simpler the facts, the more we look for an answer. Suggestions that it was a light in a native canoe or a product of pure imagination are hardly credible, for the canoe would have been dangerously far out in the Atlantic, and the record is too detailed to be one of hallucination.

In recent years another explanation has appeared that fits like the missing piece of a jigsaw puzzle. The answer, of all things, is worms!

A delicate little sea worm, one to two inches long, lives abundantly among the rocky reefs of the Bahamas. This is the fireworm, brightly luminous in the dark, and it regulates its habits according to the state of the moon.

When it is time to spawn, the worms leave their homes among the coral in shallow water and swim to the surface of the sea. The females shed their eggs with an intensely phosphorescent slime, shining with the same light that fireflies flash in summer evenings. Groups of worms arrive suddenly at a given spot at the surface, flash several times, and as suddenly disappear. If the watchers on the "Santa Maria" saw the flashing fireworms from a distance of 100 to 200 yards on a very dark night, they would undoubtedly have received the impression of a candle waxing and waning, and they could not have judged the distance. The fireworms could have produced the right kind of light. Could they have produced it at the right time?

The worms spawn every month, winter and summer, but they pick their own time. They rise only when the sun has long set and before the moon has risen. Before the moon is

From Ewing Galloway

▲ **Statue** of Christopher Columbus at Trujillo, San Domingo, one of the islands the navigator touched on his first voyage. He was once buried in the cathedral in the background, but his remains now lie in Seville

full, it is in the sky earlier than sunset, and there is continuous light. The full moon rises as the sun sinks below the horizon, and not until several nights afterward, when the moon is approaching the third quarter, is there a fair interval of complete darkness between sunset and moonrise. And so, each month, commencing a couple of nights after full moon, the worms leave the island reefs on several consecutive nights to display their ethereal light at the surface of the sea until no eggs are left.

Columbus saw the light at 10 P.M., two hours or so after sunset, an hour before moonrise, as he wrote in his journal. There is little doubt that the fireworms were busy about their luminous duties at the time the light was seen. It is only reasonable to assume it was the same light.

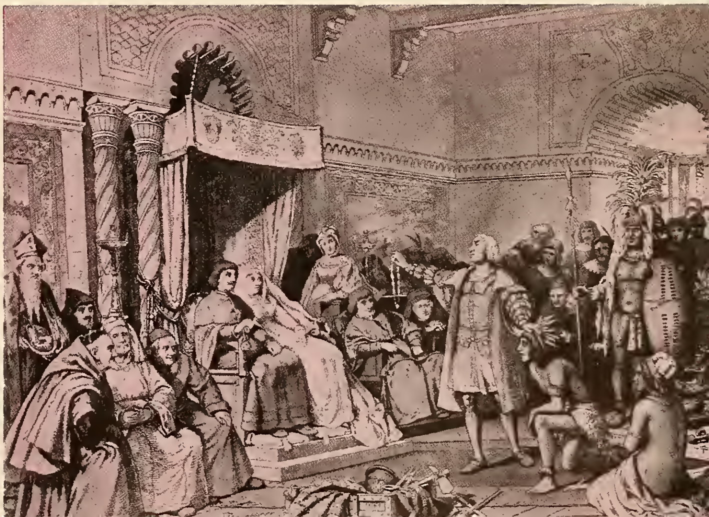
So what becomes of Columbus' San Salvador? It could not be what we now call San Salvador, or Watlings, for that island lies like an outrider along the outer bank of the Bahamas, and it would place the fireworms some 40 miles away from the reefs, in deep water where they do not perform. The "Santa Maria" probably sailed close to the reefs that lie off the northern shore of Watlings, and the spawning lights were seen at that point. The low-lying island itself, about four miles away, passed unnoticed in the pitch darkness. Cat Island is about 50 miles to the west of the reef in question, the right distance for it to be Columbus' San Salvador. That is where his expedition probably first saw land.

It is none too easy to put ourselves back into the fifteenth century and see things as they seemed during the dawn of the Renaissance, when men's minds were stirring but were still imbued with the legends and myths of medieval Europe. It was a time for adventure, but there was little experience. Columbus himself was at heart a mystic and a poet, a man with an overpowering vision, but he was not a professional navigator. The expedition was into the great unknown, and the men were afraid.

Putting out from the Canaries, the ships steered westward, and as the smoking peak of Tenerife sank below the eastern horizon, those on board must have felt that all that tied them to their past lives was severed. But 6 days later and 600 miles to the west, the invisible forces of the unseen world made their first sign. The compass needles no longer pointed to the North Star but more and more to the west, swinging a full degree between night and morning, and all were amazed, for it had never happened before. The

▼ **The reception** of the explorer at the court of Barcelona is said to have been the most magnificent in all Spanish history. He brought six Indians with him and various plants, animals, and minerals from the New World

The Bettmann



magnetic pole was unknown, but the conclusion Columbus drew was sound: the needles do not point to the Pole Star but to an invisible center not far off the line. This discovery alone would have made his name remembered.

The following day "those of the caravel 'Nina' reported that they had seen a tern and a boatswain bird, and these birds never go more than 25 leagues from the land." The phrase is significant, though it certainly does not mean that the hard-bitten sailors on the "Nina" had any great interest in birds as birds. But they knew well, as did every man in the expedition, that the Portuguese had discovered the Atlantic islands of the Canaries, the Azores, and Cape Verde by noting the direction of flight of birds at sea. It was of vital importance to know which birds rested or slept on the sea and which on land, and how far from land they could roam. So we find here a conclusion (based on the presence of the boatswain bird in particular, since it was the more precisely identified) that there was land, probably an island, somewhere within 100 miles. The bird was a sign, but was it a true sign?

All four voyages of Columbus have now been pretty well charted; and when the bird was seen, no land was closer than the Azores, 600 miles to the north. The conclusion was logical; mariners were accustomed to seeing the birds within a certain distance of land. The pitfall lay in the incompleteness of the information, which leads men astray at every turn. What the Admiral and his captains did not know was that tropic birds, or boatswain birds, merely tolerate land for the brief two months it takes to raise their families. For the rest of the year they roam the tropical ocean as far from land as it is possible to get. No one who has ever crossed the Atlantic Ocean between Cancer and Capricorn can forget the sudden visit and shrill whistle of the boatswain bird in tropical waters where birds are scarce – a white, gleaming, long-tailed creature passing on rapidly beating wings and streaking away like an animated comet. Scientists have well named it *Phaëthon*, the son of Apollo, who hurtled from the far sky into the sea. A sign of land or not, no symbol could have better graced the first voyage into the unknown ocean.

A few days later another tropic bird flew by—an early omen in a day long remembered. The compass needles turned a full point to the west, to the alarm and dejection of the mariners. This was at dawn, and it was on that same Monday morning that the weed swept by the ships —weed in which they found a live crab. Seaweed torn from a shore so recently that a hapless crab enmeshed in it was still alive; a boatswain bird; and soft breezes! Is it any wonder that "everyone was pleased, and the best sailors went ahead to sight the land first," all signs coming from the west?

Once again the signs were false, and the ships had yet to reach the mid-Atlantic. But like the variation of the compass, Columbus was seeing for the first time something unknown to Europeans, though the ancient Phoenicians—sailors who once sailed from the Mediterranean to Iceland and ventured far out into the tropical ocean—may have seen it, too. Columbus was entering the Sargasso Sea, a sea of floating weed in the middle of an ocean, a sea that became a legendary terror to seamen of later times. Great masses of floating weed sometimes cover the ocean as far as the eye can see, and strange rumors grew that ships became caught in it, finally to rot and sink.

The reality is otherwise, though no less strange. Sargasso weed, no matter how extensive it seems, hardly impedes a ship, though lack of wind may enhance the illusion. But the weed is peculiar, for it lives and grows as a floating seaweed of the warm oceans, far from land or even shallow water. Its spiky growing tips and bladder buoys give it a distinctive appearance, as Columbus well noted. And it has so long drifted with the ocean currents that sea animals have changed and adapted themselves to a life among the weed as though it were a world in itself, all of them taking on the yellow-brown colors of the floating fronds. Not only are crabs to be found among it, but peculiar small fish called fishing frogs cling to it and are so well camouflaged by color and shape that they are practically invisible. Certain small snails and worms, not to be found elsewhere in the world, also live among the weed.

Ignorance is often bliss, and had Columbus and his men known the sign of the weed and the crab for what it was, their hearts might have failed them. As it was, the weed increased as the ships sailed west, and other signs no less false came to keep their courage high. Ten days and more than 1200 miles from the Canaries they saw boobies and a whale—boobies that "sleep on shore and go to sea in the mornings in search of food, not extending their flight more than 20 leagues from the land," and a whale they thought always kept close to shore. They ran into smooth seas and a drizzling rain —weather that was a sure sign of land. And to cap it all, they saw sandpipers and a dove. Land must be near, and at sunset on September 25, all thought they could see it in the far distance. Columbus knelt down and gave thanks to the Lord.

Where were they? They were in mid-Atlantic, as far from their landfall as from their point of departure, about 1500 miles from the West Indies, from South America, from Newfoundland, or back to the Canaries! Anything that upheld their faith at this time was all to the good. Or perhaps their optimism was wishful thinking. For whales had been seen only close to shore, because men had not sailed far enough to find them elsewhere. Boobies, large sea birds like the gannets of northern seas, had been seen only in nesting colonies on islands, when they naturally stay close to the young they have to feed. And the sailors did not know the sandpipers as the phalaropes that take the ocean for their own; nor did they realize that the dove was a noddy tern, a bird with the size and plump grayness of a dove but one that ranges through the tropical Atlantic.

Hope deferred left boredom in its wake, and at least the sight of boobies—high-sailing birds with a six-foot wingspread—must have relieved the monotony of incessant sailing into a boundless ocean. The mariners knew them well, for like the tropic birds, the brown boobies include the Cape Verde Islands among their nesting places. But also like the tropic birds, they wander far from land when family duties are over. What held the interest of the men on the "Santa Maria" and the two caravels was the proficiency of these birds at fishing. Boobies are called boobies from the Spanish word *"bobo,"* for "dunce," because they pay little attention to human beings and will allow any sailor to knock them on the head with a stick. But they make up for this by their sheer mastery of air and water. Over blue water, where they belong, they dive from masthead heights or higher, suddenly pitching downward and flying fast until about fifteen feet from the water. Then the wings close, and the birds enter the water like aerial torpedoes.

The land so thankfully seen became only clouds on the horizon. Yet hope persisted, for the sea was as smooth as a river, so smooth that many sailors bathed alongside the ships. They saw a good many dorados – high-headed, voracious fish weighing as much as 60 pounds and often 6 feet long. The dorado is as oceanic as the tropic bird and one of the fastest swimmers in the sea. The bathers must have taken some pleasure in its shimmering colors, for they are a brilliant green or blue above, shading to silvery-white below, with purple and golden reflections; and they have bright blue spots on the head and back. Some of the fish were caught, and the sudden fading of the colors as the fish died on the deck made even the sailors silent for a moment.

For several days the dolphins stayed with the ships, and while flying fish are not mentioned in the journal until somewhat later, there is little doubt they were all about, for the two go together. Flying fish are recorded only once during the voyage, about a week later, and then apparently because large numbers actually landed on deck. Maybe it was just as well that most sailors were familiar with them in the seas south of Portugal, for otherwise fish that could fly might have been taken for a sign of heaven, let alone a new earth.

The flight of flying fish is a thrilling sight, no matter how often you see it. The flight starts as a swift rush at a low angle up to and through the surface, usually with the open jaws of a dorado or a bonito close behind. As the fish leaves the water, the lower lobe of the tail vibrates violently and propels the fish into the air at not less than 35 miles per hour. Then the great pectoral fins stretch out stiffly and flight begins; the silver bodies steer up and down the waves and along them, as gracefully as any petrel and at all angles to the wind. The fins are used entirely as planes, and all the power comes from the tail dipping in the water and from the wind itself. With three or four reinforcing dips, a quarter mile may be covered, and perhaps by then the dolphin may have lost the trail.

When the first true sign of land really did come, it was so mixed up with the false that it had no unusual import. On the twenty-ninth day of September, man-o'-war birds or frigates sailed overhead, and in this case the account is almost correct. The bird "makes the boobies vomit what they have swallowed, and eats it, maintaining itself on nothing else. It is a sea bird, but does not sleep on the sea, and does not go more than twenty leagues from the land. There are many of them at the Cape Verde Islands."

Man-o'-wars have been seen to swoop on an ascending booby, seize it by the legs, and turn it head over heels in midair—a sure way to make it disgorge its fish. Yet they probably get the bulk of their food by their own efforts, plunging toward the sea from great heights, making a sound like the hiss of an arrow shot into water, and then, without wetting feathers or feet, rising and tossing up the prey before swallowing it. In actuality, the skittering flying fish are literally caught between the devil and the deep blue sea.

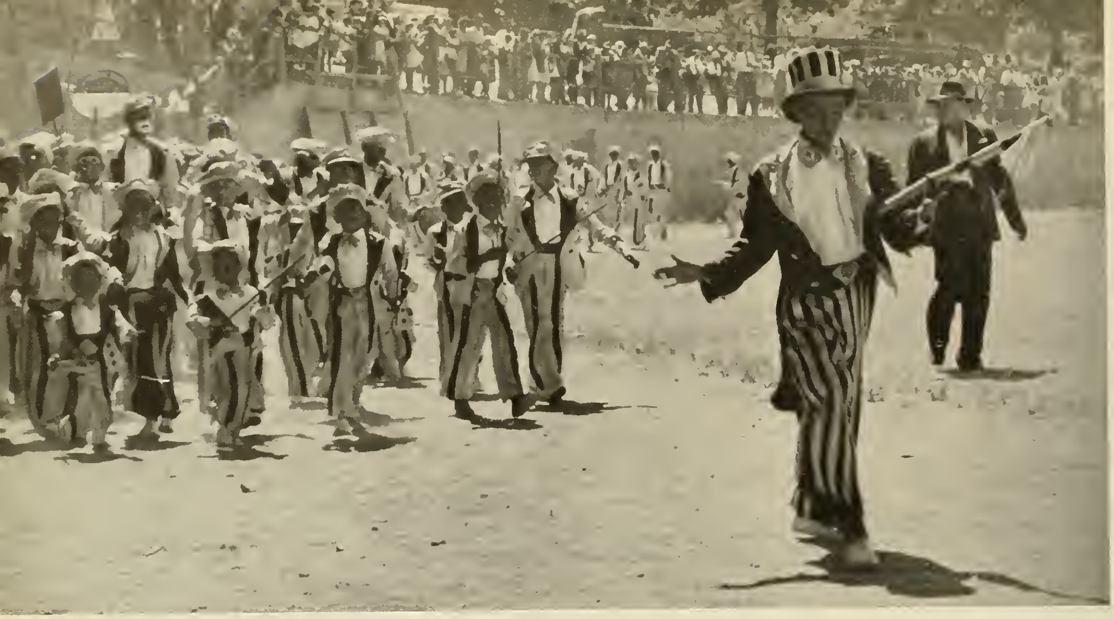
These birds are distinctly not ocean wanderers like their dainty relatives the tropic birds, and they usually cling closely to their island homes. Their great chest muscles make up a quarter of the whole body weight, and the wings are proportionately larger than those of any other bird. Yet despite, or perhaps because of, this equipment, the man-o'-war can only take flight readily from a bush or the edge of a cliff and never rests upon the water. But it can fly through gale and hurricane and can make much longer sorties from the islands than the 20 leagues of Columbus gave them.

When he saw man-o'-war birds for the first time, the nearest land was Puerto Rico, about 700 miles to the south. This is puzzling, for careful studies have indicated that man-o'-war birds do not ordinarily fly more than about 200 miles from their breeding or resting stations. Severe storms have no doubt occasionally carried them farther. Or maybe there is a mistake in identification here.

So for another week, boobies and frigates, dorados and flying fish, and weed marked the track of the three small ships, until suddenly the Bahama banks rose steeply from the deep ocean abyss, and the flat islands of Paradise stood in their way. They had come to land.

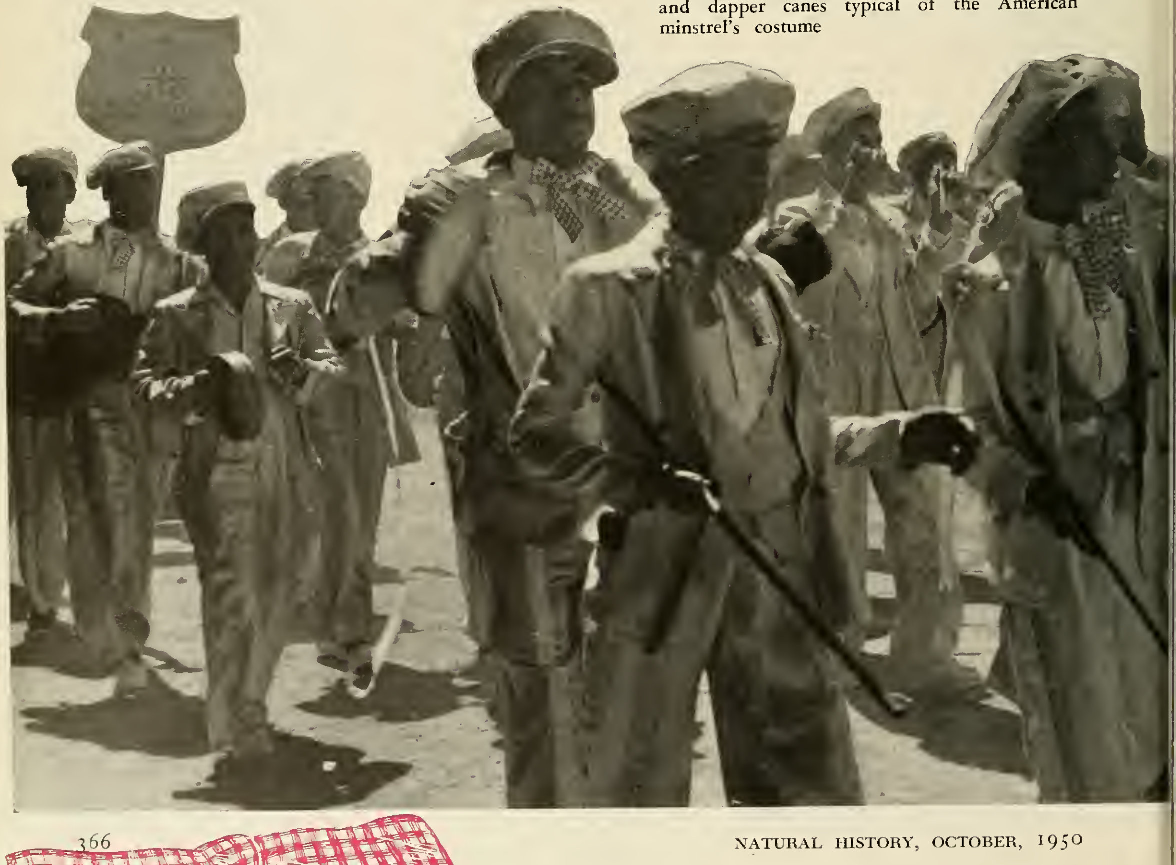
They found the children of the dawn on the islands—comely, naked, gentle Indians who greeted them in innocent friendliness. Columbus was much taken with them and with the soft, calm beauty of the sunny isles; but he had a purpose to fulfill and could not linger long. He went on to take possession of all the little islands for the Sovereign of Spain. But more than this, he was searching for the island of Zipangu, described by Marco Polo as having abundant pearls and palaces roofed with gold. This island (actually Japan) and the courts of Kublai Khan on the mainland of China, were the real objectives, and gold was now the sign to be followed in place of birds and weed. Some gold was

Continued on page 382



▲ "UNCLE SAM" swings his baton as he leads a choral group past the judge's stand. The exciting musical festival of the Cape Negroes is replete with Americana

▼ THESE CHORALERS imitate the long bow ties and dapper canes typical of the American minstrel's costume



DIXIE IN REVERSE

The Negroes of South Africa are borrowing back some of the purely American adaptations that their cousins in the United States have developed

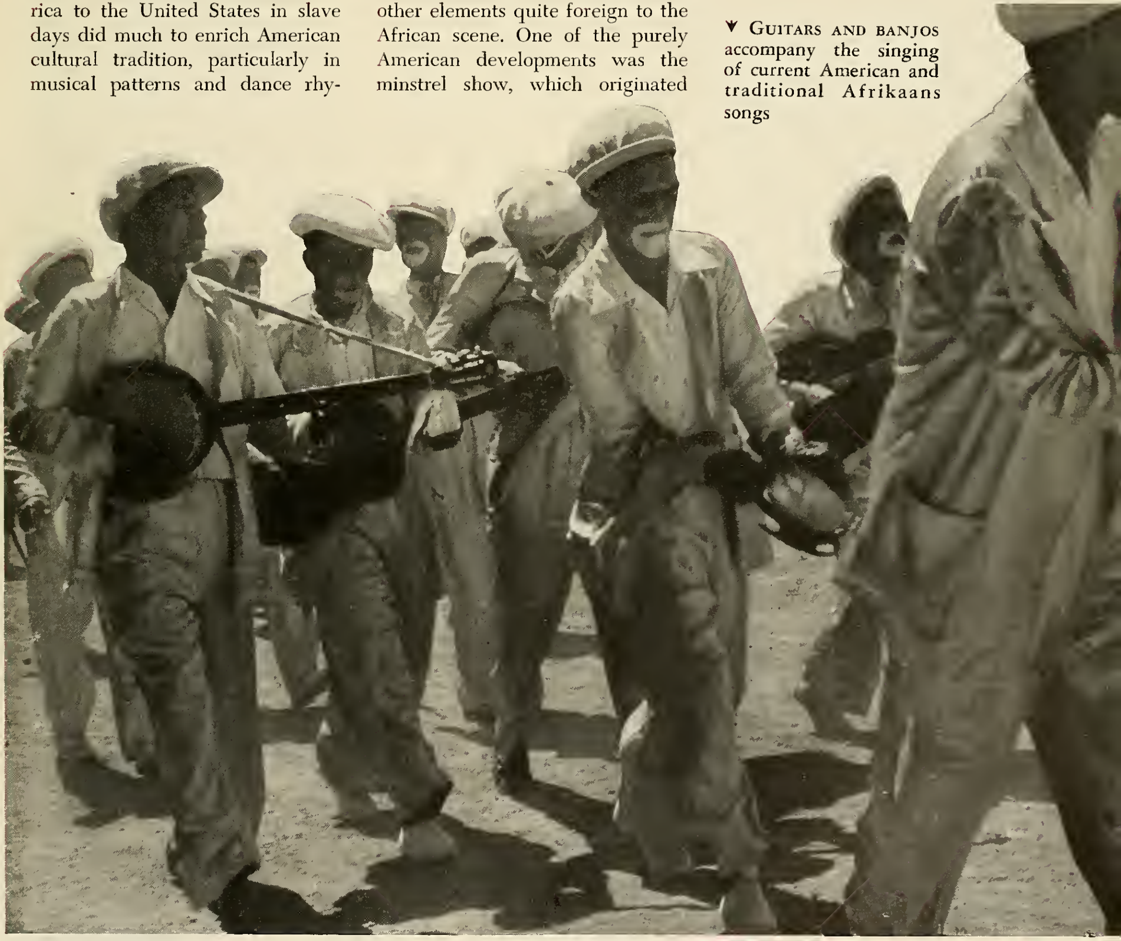
By QUENTIN KEYNES

Photographs by the author

THE cultural elements that the Negro brought from Africa to the United States in slave days did much to enrich American cultural tradition, particularly in musical patterns and dance rhythms. In this country these traditions were influenced, in turn, by other elements quite foreign to the African scene. One of the purely American developments was the minstrel show, which originated here early in the nineteenth century—a kind of musical comedy in which Negro spirituals and humor were adapted to an altogether new national background.

Strange as it may seem, this purely American institution is now being borrowed back by the natives of Africa—but in reverse. At an annual carnival staged in Cape Town, Union of South Africa, the Cape Negroes smear their mouths with white, Al Jolson style, don American costumes, sing American songs, and carry American signs.

Over 1000 of these high-spirited people take part in this carnival at the fairgrounds, chanting many current American and traditional Afrikaans songs. One of the most



▼ GUITARS AND BANJOS accompany the singing of current American and traditional Afrikaans songs

▲ "Cakewalking" across the fairgrounds in true minstrel fashion. Lips are painted white, mimicking the Al Jolson style

interesting numbers is an old Cape "Malay" melody called "Daar kom die Alabama."

The singers march by in groups to compete for the choral prizes, and each group is good-naturedly identified with the name of an American state. The Louisiana group goes so far as to bring Louisiana into the British Empire by including on the sign: "May God Bless Our Royal Highness Bonny Prince Charles of Edinburgh."

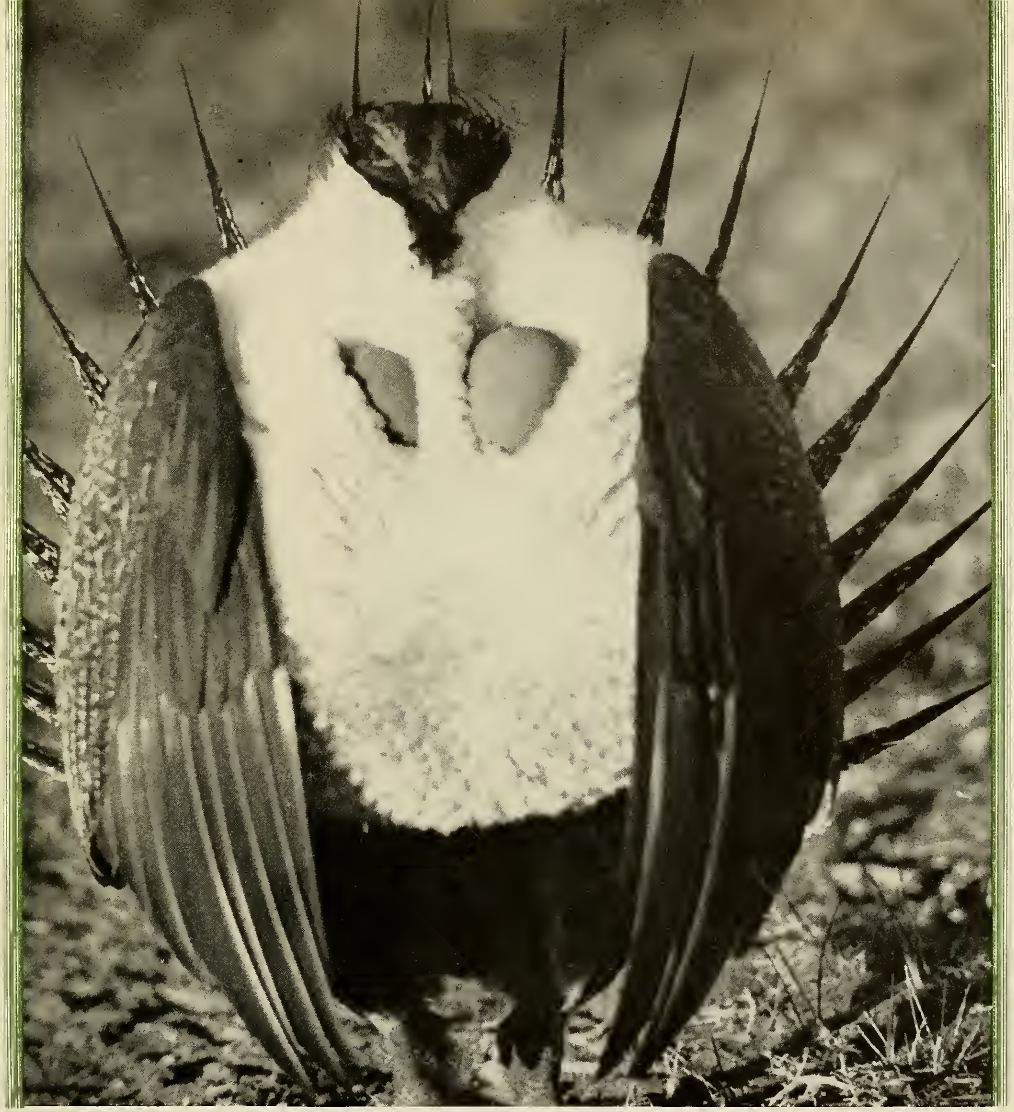
Banjos and painted mouths are everywhere. One figure proudly represents Uncle Sam himself in red-striped pants, top hat, and blue-tailed coat!

The origin of the carnival dates from the visit of the famous Confederate raider, "Alabama," to Cape Town in July, 1863. As the vessel approached the harbor, a Union barque, the "Sea Bird," which had desperately sought to avoid the Confederate ship for some time, made its appearance from the opposite direction. It was soon evident to the hundreds of local inhabitants, who had by this time lined the water front, that the raider was intent on seizing the hapless Union ship. The "Alabama" fired a blank charge at the fugitive, bringing it immediately to bay, and steamed triumphantly into Cape Town with the surrendered ship in tow. Visitors streamed on board the captor, and her captain was the hero of the day. The happy ending to this story came when the local Prize Court awarded the "Sea Bride" as a legal capture. For years this exciting event was discussed at every bar in the Cape and so eventually found its way into song.

The curious American influence on this musical festival may have come from some members of the "Alabama's" crew who were inadvertently left behind when she sailed. Other sources are undoubtedly the many American movies shown in the theaters of Cape Town. At any rate, everyone concerned has a wonderful and exuberant time.

▲ The "feather headdress" may have been imported from the American Indian or it may represent an adaptation of a native African design

◄ This group identifies itself with the State of Pennsylvania when competing for musical honors. The partially white faces are variations of the white-lips theme



▲ A HEN'S-EYE VIEW of a male sage grouse displaying. At the height of the display, the inflated air sacs, partially hidden by the white ruff, collapse with a *plop* that can be heard for over a mile on a calm day

SAGA of the Sage

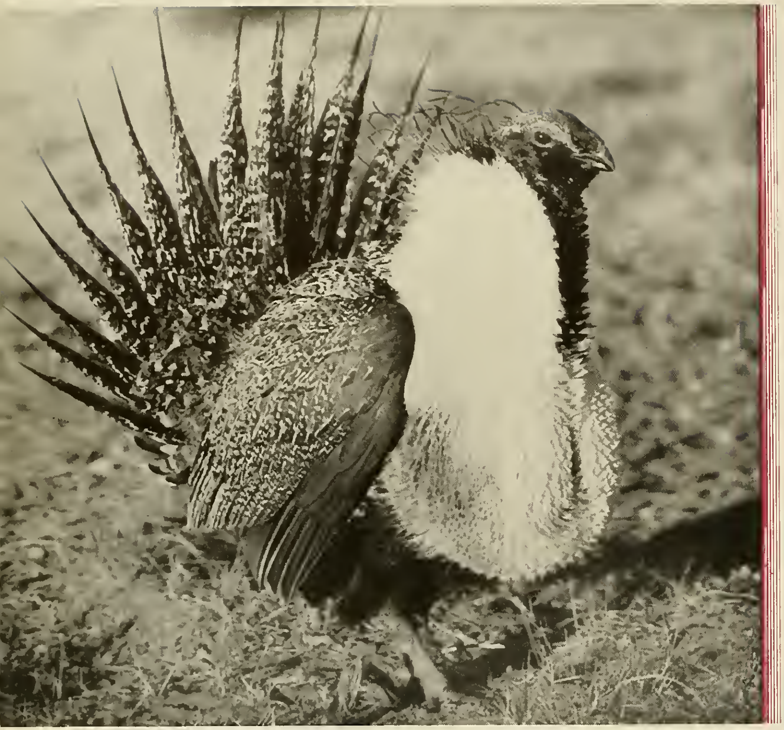
An early morning vigil on the sagebrush plateau of Wyoming results in a thrilling educational film on the courtship ritual of the sage grouse

By CHARLES W. SCHWARTZ

Photographs by the author

OF all avian courting displays, those of our various prairie grouse are among the most spectacular and colorful. Pinnated, sharp-tailed, and sage grouse have in common the habit of gathering each spring on ancestral sites where the cocks perform their age-old nuptial rituals at dawn and dusk.

In the course of filming the sound picture "Sunrise Serenades" for the American Museum of Natural History, which depicts the strange court-



▲ SOME of the dances and accouterments of the Plains Indians are believed to have been patterned after the displays and plumage of the prairie grouse

ship of these three prairie grouse*, Edgar M. Queeny, producer and photographer, Ralph Piper, sound technician, and I as biologist and co-photographer journeyed to different parts of their ranges. On the vanishing bluestem prairies of Missouri we photographed and recorded the sound of the mincing, dancelike steps of the pinnated grouse and its booming song. The aspen pothole country of southern Saskatchewan and southern Manitoba was the locale where we filmed the running dance of the sharptails. And on the 7000-foot-high sagebrush plateau of central Wyoming we pitched our blinds and recorded the pompous strutting of the sage grouse, shown in these photographs. The latter impressed us as the most spectacular of the three displays.

The strutting ground where we filmed this epic was an opening of little more than an acre in the ubiquitous sage. The sandy soil, supporting a sparse growth of hardy grasses, was marked by numerous grouse tracks, a few scattered feathers, and an accumulation of droppings. According to our host, Bob Patterson, who is making a study of the sage grouse in Wyoming as a biologist with the Wyoming Game and Fish Commission, there were 47 such strutting grounds in the 250 square-mile area he had under observation in this vicinity. This is an average of one ground for each five square miles.

Sage grouse cocks customarily display on their strutting grounds at dawn and dusk from late March until early June. But at the height of their mating season, in mid-April, which we selected as the time of our observations, they may even continue their display throughout the night.

It was 3:45 A.M. when we drove up to our blinds on the strutting ground we had selected the previous day. The headlights of our car momentarily illuminated the scene, and we could see the sage grouse cocks actively displaying. Our sud-

▼ EDGAR M. QUEENY beside one of the camouflaged blinds from which the photographs were taken. His 16 mm. Maurer camera stands on a unipod of his own design. The windows close by zipper

➤ AFTER the morning's recordings, Ralph Piper has removed the cover of the blind and is preparing to audit some of the sage grouse sounds den appearance stopped the show; some of the cocks took wing, while others retreated into the shadows of the surrounding sagebrush. We took advantage of this lull to scramble into our three blinds. One was used exclusively for the sound equipment, the other two for photography. All had been placed on the eastern edge of the strutting ground so that the rising sun would light our "stage" to best advantage — a necessity when using color film just after sunrise. The camera blinds were spaced about 80 feet apart in order to achieve different shooting angles and to ensure better coverage of the ground.

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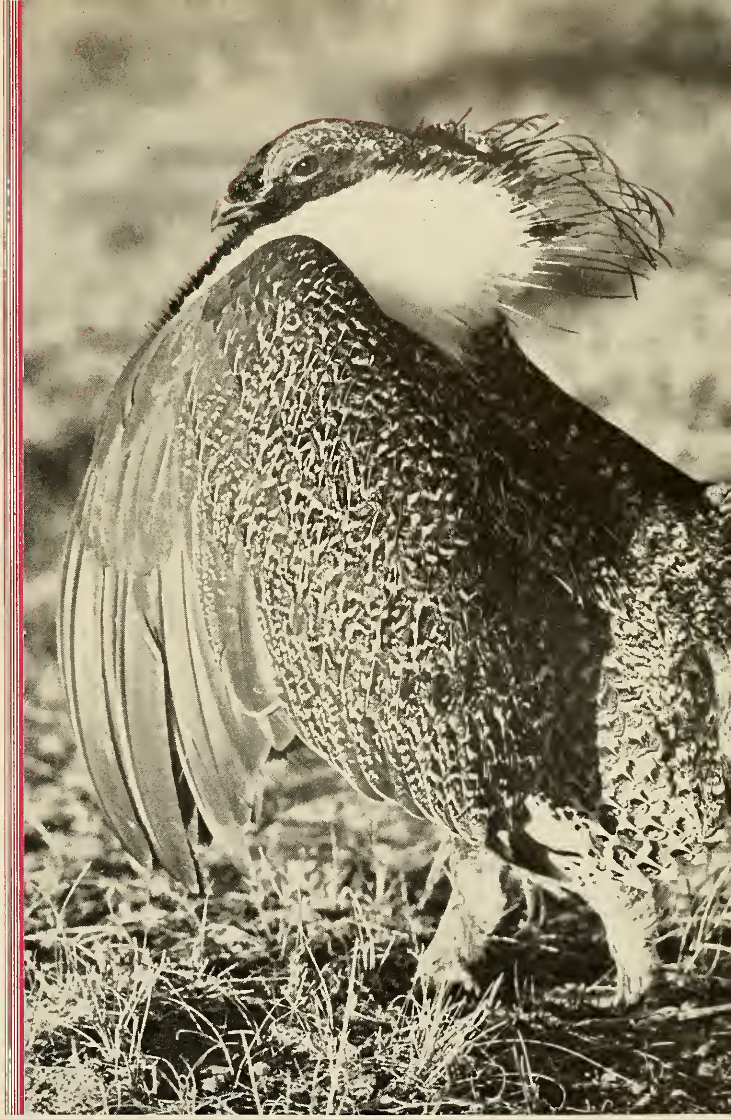
* "Sunrise Serenades" was released recently by Encyclopaedia Britannica Films, Inc. Another motion picture, a ten-minute classroom film entitled "Grouse of the Grasslands," will feature the courtship of the pinnated grouse. This will be released on October 15 by the same organization.—ED.

Within five minutes the cocks started to return and promptly resumed their displaying. In the dim moonlight, their huge white-neck ruffs stood out like apparitions, and the weird sounds they made while displaying added to the enchantment of the scene. As the darkness imperceptibly dissolved into daylight, the birds became more and more visible. Because the presunrise light was too weak for good color movies, we devoted this time to observing and enjoying the spectacle before us. There were 102 males, rather evenly distributed over the open strutting ground and in the sagebrush roundabout. Patterson told us that the number of males utilizing different strutting grounds varied considerably. The smallest number he had seen was 11, the largest, 450. He believed that on any extensive sagebrush tract the number of males on the strutting grounds represented the total male population for that area. It is probable that each ground is regularly attended by the same cocks.



▲ **Profile** of a strutting sage grouse cock. The under surfaces of the wings are scraped against the stiff basal portion of the white neck ruff to create the swishing sound

One cock, which was strutting less than twelve feet from my blind, afforded a splendid opportunity to observe the imposing display. With his long tail feathers spread fanwise, head held high, and wings partially thrust forward, he advanced a few steps. Then, with a slight retraction of the wings and a jerk of the head and neck, which caused the stiff feathers on the basal portion of the

▲ THE WHITE RUFFS of the strutting cocks cause the birds to stand out conspicuously. Most of the cocks occupy the opening in the sage, but a few possess territories in the surrounding sagebrush

ruff to scrape against the underwing surfaces, an audible "swishing" sound was produced. These movements and the sound, which reminded me of the noise made by lightly brushing a hand over taffeta cloth, were quickly repeated. During these actions, the strutting cock rapidly inhaled and then exhaled the air into the esophagus, whose thin walls thus became inflated to form the pendulous air sacs. After the third inhalation, the air would be quickly exhaled, causing the air sacs to collapse with a sharp "plop," which resembled the sound of an acorn falling into water. The whole process, culminating in the plopping, was repeated successively at intervals as short as ten seconds.

Through the peepholes of the blind other birds could be seen strutting vigorously, and in the quiet morning air the swishing and plopping intermingled in a veritable sunrise serenade. When heard at close hand, these sounds do not seem harsh or loud, but on a calm day the plopping carries for over a mile.

As this grouse strutted pompously before the blind, a neighboring cock, rattling his tail feathers and uttering a grunting sound like a rooting hog, suddenly sidled up to him. Immediately, the strutting cock ceased his display and with a couple of rapid blows of his wings buffeted his opponent, who reciprocated in a like manner. After this round, the two contestants paused for a second or two and then struck out again with their wings. Though the onslaughts were spirited, little damage was inflicted, and only a few feathers floated up out of the swirl of dust caused by the conflict. Following this engagement, the birds paused again, and without further ado the challenger pivoted about and went strutting off to his original stand about fifteen yards away.

We noticed that such bouts were common throughout the strutting ground. It is not unlikely that they represent disputes over territories maintained by individual strutting males. Of course such territories have no hard and fast boundaries, but each male did seem to exert a dominant influence over the few square yards of sandy soil he patrolled. A similar territorial pattern is observed on the courting grounds of other species of prairie grouse.

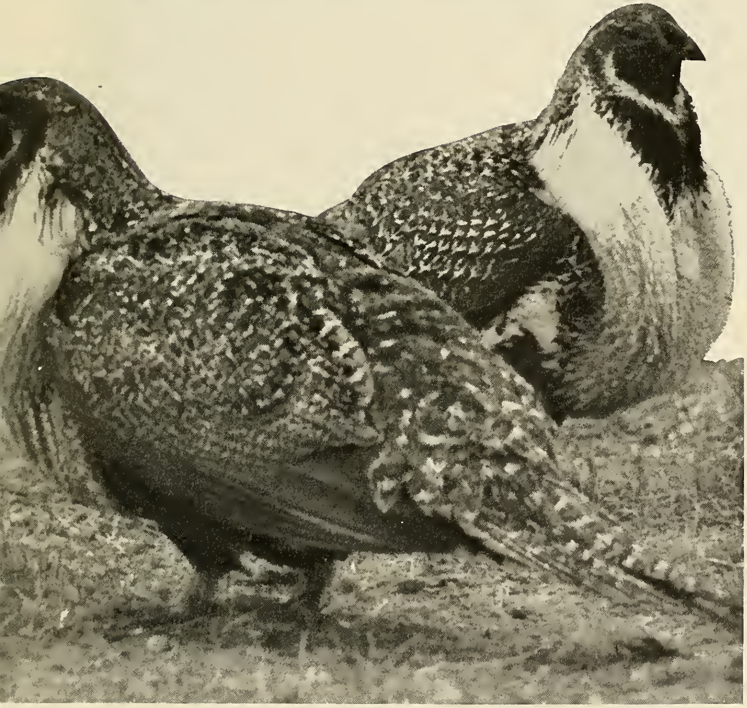
At the far end of the strutting ground, a few hens could be seen making their way along its edge. Even at this distance they were easily distinguished from the cocks by their lack of a white ruff and by their smaller size and general behavior. In contrast to the pompous appearance of the cocks, the hens seemed almost demure and shy. Occasionally they would pick up a morsel of food, paying scant heed to their ardent suitors, who in the hens' presence displayed even more spiritedly.

Gradually the number of hens increased until ten were grouped in a rather loosely organized flock while four others strayed about the ground individually. The flock of ten spent their time in the vicinity of one particular male, and four of these hens were observed to mate with this cock. Since Patterson had seen 40 females on this strutting ground a few days earlier, it is likely that the peak of mating was almost over and that even fewer hens would appear hereafter each day. Just before sunrise, the hens started to wander off individually through the sagebrush. Those that had mated successfully probably would not return to the ground but would seek a secluded site in the sage in which to nest. Females whose nests and eggs have been destroyed doubtless return to the ground later and mate again, for the cocks continue to display until early June. Thus, the prolonged use of the strutting ground has its function.

With the departure of the hens, the males' strutting diminished in vigor and frequency, and they spent more time in territorial disputes or just idling and preening their feathers. With the coming of sunrise and its welcome light, we started to record on film the scene we had been so eagerly observing. Although light conditions kept improving for photography, our chances of filming good activity steadily decreased because the climax of the morning's activity had been reached. To overcome some of this difficulty, we resorted to a ruse we had used successfully to stimulate activity in the pinnated and sharp-tailed grouse. We played some of the sounds recorded earlier in the morning during the period of intense displaying by the cocks in the presence of the hens. The results were astonishing. Upon hearing this vigorous plopping and swishing, the cocks were aroused out of their lethargy and were stimulated to renew their energetic displaying. Thus, in good light we were able to secure photographs of activity that otherwise would have been impossible. However, after a time, even this artificial stimulation began to lose its effect and most of the grouse quieted down.

Gradually the birds began to leave the ground, some flying and others ambling off through the sage. By 7:30, all had vanished not to return until dusk, when they would again fill the desert air with the sounds of their wooing. With the departure of the last bird, we eased out of our cramped quarters. Only then did we realize that we had spent four hours witnessing one of the most remarkable of wildlife dramas. While dismantling our camera equipment, we discussed with Bob Patterson some of the problems concerning the future of this bird.

According to him, the original range of the sage grouse coincided with the distribution of sagebrush and salt-desert vegetation. This area roughly encompasses the Great Basin and central Rocky Mountain region from 2000 to 7500 feet above sea level. The bird depends solely upon sagebrush and associated plants for the major part of its habitat requirements during all seasons. In times of heavy snow and severe ground blizzards the sage at high elevations is sometimes covered by snow. Then flocks numbering several hundred birds and composed mostly of females and juveniles may fly as far as 100 miles to lower elevations where the sagebrush remains exposed. Often these areas represent extremely arid regions, which cannot be utilized for breeding range in the summer.



▲ Two sage grouse cocks pause before buffeting each other with their wings in what might be considered a dispute over courting territories. Little harm results except the loss of a few feathers

A chemical analysis that was made by the Wyoming Experiment Station shows the leaves of the common sagebrush (*Artemisia tridentata*) to be highly nutritious. The protein content is equal to and the carbohydrate content greater than that of the best alfalfa meal; the amount of fat is twelve times that of alfalfa meal. No wonder the sage grouse utilizes this plant almost entirely as a winter food, since the fat has a high capacity for producing heat. Even during the winter of 1948-49, which is considered one of the most severe in the history of Wyoming, there was no evidence of abnormal loss of sage grouse. They were able to obtain their customary nourishment from the sage.

The inroads of civilization have dangerously lowered the grouse population. Agricultural reclamation projects embodying irrigation of desert land and heavy grazing by domestic livestock have greatly reduced the original domain of the sagebrush and the salt-desert shrub vegetation. A by-product of these "advancements" — indiscriminate shooting — has likewise influenced the birds' decline. The immediate plans for this vast arid domain call for the development of numerous dams and a network of irrigation projects. These will harm not only the sage grouse but numerous other species of wildlife, including big game. Because extensive and contiguous areas of native vegetation are essential for the sage grouse, this bird will inevitably decline unless special provision is made for its survival over reasonably large areas.

AMNH Photo

▲ PHOTOGRAPH of a greatly enlarged model of the male malarial mosquito (*Anopheles maculipennis* Meigen)

The Lady LIVES ON BLOOD

Little-known facts about a well-known creature—the mosquito

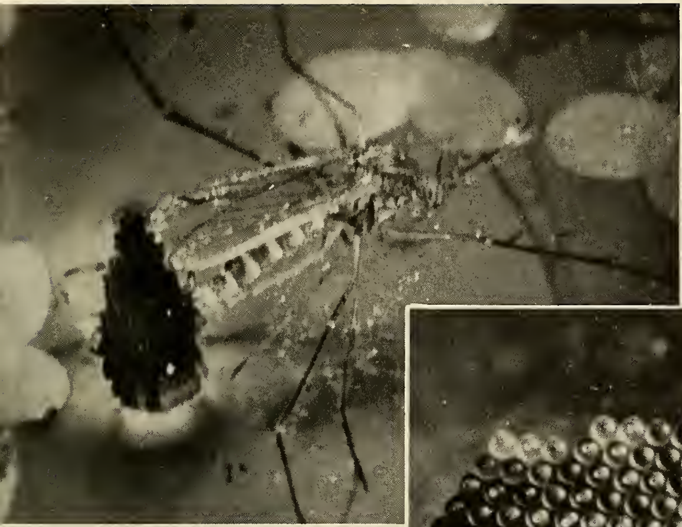
By MARSTON BATES*

Photographs by LYNWOOD M. CHACE
for Encyclopaedia Britannica Films, Inc., unless otherwise credited

EVERYONE is familiar with mosquitoes. Those poor people who have never been outside the region of Western civilization characterized by modern plumbing may plausibly deny acquaintance with bedbugs, lice, ticks, leeches, or even fleas; but they have all encountered mosquitoes either on picnics or, more intimately, in the bedroom.

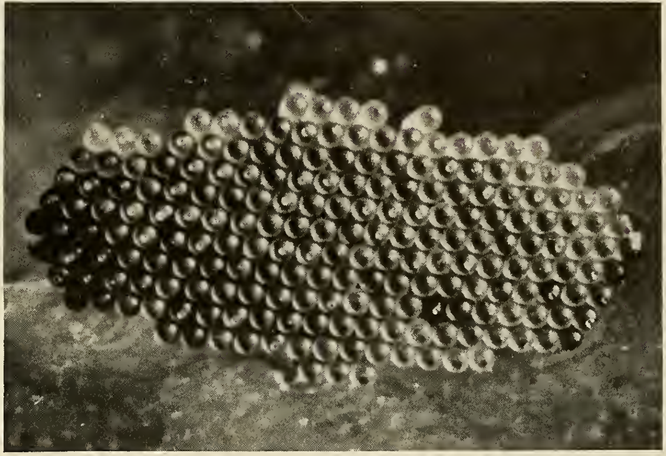
Most of us have repeatedly gone through desperate nocturnal conflicts with a single mosquito that has somehow found a hole in the screening and come in to buzz triumphantly first in the left ear and then in the right before settling down to test the blood supply on an exposed shoulder. It is just a test, because the mosquito has already gone when you make the first swat.

I have spent many hours of my life inside large cages with mosquitoes, watching the intimate details of their life, including their individual and collective idiosyncrasies in



◂ A MOSQUITO in the act of laying a raft of eggs on the surface of the water. The larvae of all mosquitoes develop in water

▾ THE RAFT OF EGGS looks like this under strong magnification



biting. I have learned a lot about the character traits of *Anopheles maculipennis* and *Culex pipiens*, but none of this knowledge is of any avail during that midnight struggle. After that first swat, my body tenses in expectation of the next attack. I think I feel a bite and swat again, but a buzz in the ear tells me that the "bite" was probably one of those tricks of sense perception that the psychologists are always fussing with. I decide that the proper course is to let the mosquito settle down and fill up with blood, so that she will go off in a corner somewhere to start the digestive process and stop this silly braggart buzzing.

I try to relax, and presently a series of sensations on one side of the nose informs me that the mosquito has really settled down. I begin to think, why let the brute get away with this? The proboscis, I reflect, is surely well inserted by now and the mosquito sufficiently preoccupied with finding a capillary so that I'll be able to get in a really crushing swat.

I cautiously remove my arm from under the bedclothes and with infinite patience bring it into position for the blow, which is delivered with speed and precision. I feel my bruised nose to see whether I can detect the squashed mosquito. Nothing. Quite possibly the body fell off onto the sheet. But a minute later I hear that damned buzz again. So I crawl wearily out of bed to get the bottle of dimethylphthalate from the bathroom, and after smearing my face, with due regard for eyebrows and eyes (conditioned from times when I didn't take due regard), I sink back into sleep, though still too mad at the *Culex* to be properly grateful for the chemical accomplishments of modern science.

It is, of course, only the female of the species that bites. Not much is known about the food habits of the males, but they have been caught frequently on flowers, or sucking the easily got-at juices of things like fruits and manure. In Albania, I once tried baiting traps for male mosquitoes with all sorts of substances, and I found that I could catch a few with absorbent cotton moistened with perfume from my wife's dressing table. Cow manure was just about as attractive as the perfume, though.

Male mosquitoes are easily distinguished from females because of their conspicuous, feather-like antennae. There are a few records in the scientific literature of attempts at blood sucking on the part of male mosquitoes. When such misguided males have been caught and carefully examined, however, they have always turned out to be hermaphrodites—examples of a queer blending of male and female characters in a manner that is characteristic of insects. One side of the body may be male, the other side female, or the head male, the abdomen female, or something of that sort. These anomalies, called "mosaic gynandromorphs," are possible because sexual characters are determined directly by the hereditary materials of each particular cell, and not indirectly through the action of hormones, as is the case with us and other mammals.

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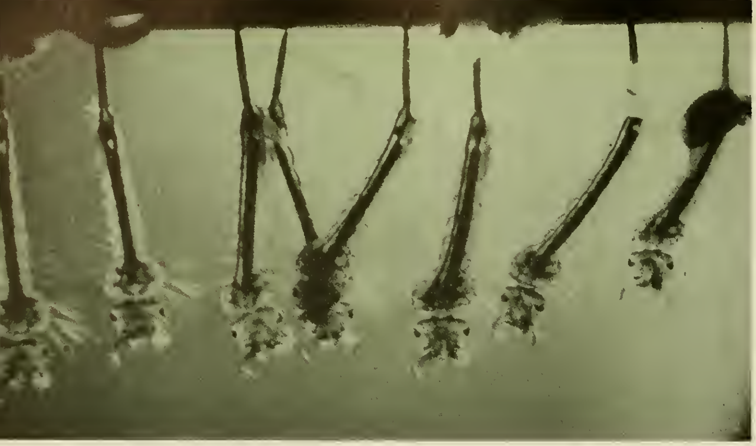
* During his more than 20 years of research, Dr. Bates has enjoyed an unusual variety of field explorations, beginning with several years in Central America and the West Indies. Since 1935, he has been with the Rockefeller Foundation, primarily as a field biologist for the International Health Division—in Albania, Egypt, and Colombia. In Colombia, he headed the Foundation's laboratory for yellow fever research for eight years. He now has a new assignment—the human population problem.

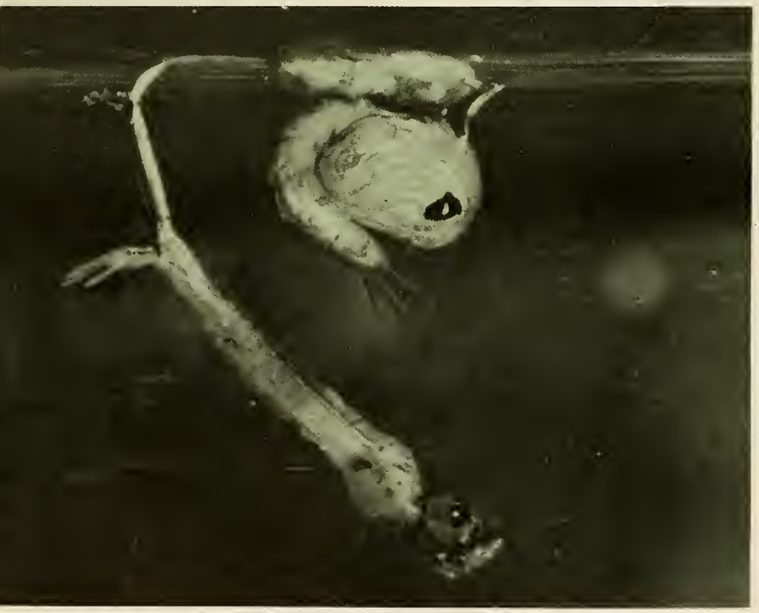
He uses the title of the present article with apologies to Edwin Way Teale, who originated it in a review of Dr. Bates's comprehensive and authoritative book, *The Natural History of Mosquitoes.* His more recent book, *The Nature of Natural History*, is a Natural History Book Club's selection.—ED.

It is the blood-sucking habit of the female mosquito that gives these insects their peculiar importance for man. Not so much because of the annoyance caused to the human blood donor as because of the incidental possibility of transmitting disease. Many of the disease-causing parasites of man circulate in the blood stream, and an insect picking up a sample of this infected blood and later probing some new victim for the next blood meal, provides a fine transportation arrangement—from the point of view of the parasite—for getting from one man to another.

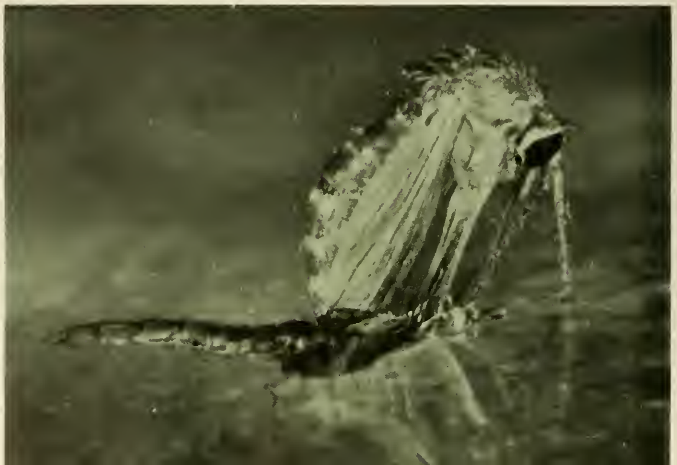
The blood sucking habit must be a very ancient one with mosquitoes. Fossil mosquitoes from the Oligocene, some 40 million years ago, look hardly any different from the mosquitoes of today, and presum-



▲ The larvae hang from the surface of the water and breathe through tubes that reach the air above



▲ The larva (*left*) develops into a pupa (*right*). The latter emerges from the larva case, which is seen above it in this view. The creature is still far from resembling an adult mosquito



➤ A creature of the water transforms into a creature of the air: a female mosquito emerging from the pupa at the surface of the water ably they had the same habits. There has thus been plenty of time for the mosquitoes and the parasites to work out mutually satisfactory arrangements for exploiting the vertebrate blood supply.

As long as mosquitoes were regarded merely as bedroom or picnic nuisances, they were given very little attention by scientists. But with the discovery, at the turn of the century, of their role in the spread of malaria and yellow fever, two of the most widespread and deadly of human diseases, they came in for a great deal of attention indeed. As a result of this study, yellow fever has been brought as completely under control as smallpox. Malaria is still public enemy number one for a large share of mankind, but in many parts of the world it has been eliminated as a health problem, and where it is still rampant, the difficulty is not so much a lack of knowledge as a lack of the funds and organization for the necessary public health measures. In the course of these 50 years of study, we have incidentally learned a great deal about mosquitoes.

⮝ Now the mosquito is completely out of the pupa case, which is behind the insect on the surface of the water

⮝ **Extreme close-up** of female mosquito emerging from the pupa

The most recent complete list of the mosquitoes of the world was published in 1932, and at that time 1400 different kinds were known. I once calculated that an average of 40 supposedly new kinds have been described every year since 1932, which would bring the total well above the 2000 mark. But many of the "new" kinds turn out to be mistakes, the new name becoming a synonym of some older name, so that 2000 is probably a safe estimate for the known kinds of mosquitoes in the world.

South America and the Orient have the largest variety, with over 500 species each. About 400 species are known from Africa, and 200 from Australia. North America, with 121 species in the most recent catalogue, and Europe with 125 species, have less variety—but they make up

▲ The mosquito in the act of drinking human blood. Only the female bites. Most kinds of mosquitoes cannot produce eggs unless they get blood

for this in number of individuals. As one goes north in either hemisphere, there is a steady decrease in the number of different kinds of mosquitoes liable to be encountered, but there is no corresponding decrease in the number of bites. The world's highest mosquito content per cubic foot of air probably occurs somewhere in Alaska or Siberia.

A man who gets caught in a place where there are millions of mosquitoes looking for a source of blood cannot help but wonder what all of these mosquitoes would have done if he hadn't happened along. All of the evidence indicates that most kinds of mosquitoes cannot develop eggs until after they have secured a meal of blood. If a female fails to find a victim, she is doomed to die childless, her function of reproducing the species unfulfilled.

A French scientist, Emile Roubaud, discovered that one variety of the common house mosquito, *Culex pipiens*, can develop eggs without a blood meal. This discovery led to extensive investigations by many scientists, resulting in dozens of learned papers and in the discovery of four other kinds of mosquitoes that can develop eggs without blood. Curiously these particular species that really don't need blood are among the most vicious and bloodthirsty of all mosquitoes. If they can get a blood meal, they lay more eggs than if blood is denied them; but they can be carried along very successfully in the laboratory for many generations with no richer food than apples and raisins.

For the sake of completeness, I had better note here that there are a few groups of mosquitoes in the tropical forests that have taken up more pleasant habits—bright, metallic green and blue fellows that buzz about in the sunshine visiting flowers. A few have acquired very queer habits indeed, like the African and Malayan *Harpagomyia* that station themselves along ant runways and tease the passing ants into giving up honey. The *Harpagomyia* places itself directly in front of an advancing ant, sometimes even nipping the ant between its front legs, and not releasing it until it stops and opens its jaws, when the mosquito thrusts the swollen tip of its proboscis into the ant's mouth and rapidly absorbs the food offered.

But the basic food association of mosquitoes is with blood, and since disease transmission depends on biting habits, these have received particular attention from scientists. Work on biting habits, for instance, has been important in efforts to discover exactly which kinds of mosquitoes are responsible for disease transmission in different places. Laboratory studies show that any species of *Anopheles* can transmit malaria, but in a given place there may be a dozen or so different kinds of *Anopheles* breeding in different sorts of water. To control them all might be impossibly expensive, and it becomes necessary to determine the relative importance of the various species. It usually turns out that only one species is primarily responsible for malaria in a given region, and by learning the habits of this species, control work can be greatly simplified.

When a mosquito has filled up with blood, she goes off somewhere to digest the meal—a process that takes from two days to a week, depending on the kind of mosquito and on the temperature. She starts with the abdomen red and distended with blood and ends with it distended with eggs. The number of eggs depends on the kind of mosquito, on the amount of blood that she managed to get, and on the kind of blood. Human blood isn't necessarily the best; in one series of experiments, mosquitoes that fed on canaries, guinea pigs, and rabbits produced more eggs per milligram of blood than mosquitoes that fed on men or monkeys. In any case, the eggs are fairly numerous, 100 to 400 being developed per blood meal.

Digestion completed, the mosquito's next problem is egg laying. The larvae of all mosquitoes develop in water—one of the few statements I can make that needs no exceptions or qualifications—so the mosquito must put the eggs in some place where the larvae, when they hatch, will find suitable water. The common domestic *Culex* mosquito finds a rain barrel or puddle, sits on the water surface, and extrudes the eggs one by one, arranging them into a "raft." The eggs are held together by a sticky substance with which they are covered, and the form of the raft is determined by manipulations of the hind legs of the mosquito. Unless disturbed by a water beetle or an inquisitive scientist, the mosquito fixes its whole abdomen-full of eggs into one raft; this finished, it flies off to look for another meal.

The *Anopheles* mosquitoes mostly lay their eggs in ponds, marshes, or areas of quiet water along the margins of lakes. The egg laying is carried out during a sort of hovering dance in which the mosquito bobs up and down over the water surface, dipping down every once in a while to "taste" the water by sticking in a leg (taste buds in insects are mostly on the legs), but otherwise dropping the eggs as she dances along several inches above the water.

▼ The male mosquito is recognized by his feather-like antennae. He feeds on fruit and vegetation and has no proboscis for piercing skin

Each kind of mosquito has its favored kind of water accumulation for breeding, and some kind of mosquito has learned to utilize almost every imaginable type of breeding place. For the most part, the larvae are closely associated with the water surface, hanging from the surface film and getting air through a tube that breaks the water surface at the tail end of the body. Because of this habit, mosquito larvae are never found in the open water of lakes, where they would merely serve as fish food, or in places where they would be damaged by wave action or water currents. In lakes or large streams, larvae are found in places where they are protected by vegetation; and while many species breed in small, swift streams, their adaptations are to keep out of the current, rather than to resist current action. In such streams, the larvae are found in seepage on gravel bars, in quiet side eddies behind boulders or under waterfalls, and in other places of the sort.

The queerest breeding places are in the tropical forests. In those regions, there are numerous unexpected places in which water accumulates, and every such place seems to have its peculiar species of mosquito larva. I have spent a deal of time in the South American rain forest trying to imagine places where water might occur; if I reasoned correctly and found water, I usually found also some new kind of mosquito.

A very common breeding place is the water that accumulates in rot holes in trees—and such tree holes are used by mosquitoes in the north as well as in the tropics. In South America, the bromeliads—the plants of the pineapple family—provide the habitat of dozens of species of mosquitoes. These plants are epiphytes, living perched on the branches of forest trees, and their long narrow leaves grow out of a water-tight base that forms a structure called a "tank" by botanists. All sorts of debris accumulates in this base, forming a rich infusion that provides the plants with food. It also gives shelter to a whole special fauna of aquatic organisms, including dragon-fly larvae and tadpoles as well as mosquitoes. The leaves of many tropical plants allow water to accumulate at their bases—this is true of banana plants, for instance —and even a thin film of water serves for certain specialized types of mosquitoes. The large upright flowers of some plants collect water, and such flowers also have their special mosquitoes.

The forest fauna that interested me most was that of bamboos. The hollow bamboo stems are often perforated by birds or by boring insects, and whenever a hole has been made into the stem, water accumulates in the internode. Some of these worm holes are very tiny indeed, so that one cannot imagine a mosquito squeezing through; yet when the bamboo is cut open, water and mosquito larvae will be found. These bamboo mosquitoes, we discovered, have very special habits. To breed out adults, we would put the larvae in test tubes plugged with absorbent cotton; but these bamboo mosquitoes, when they hatched in such a tube, would simply wriggle through the cotton plug and thus escape. We couldn't keep them in cages covered with ordinary mosquito-proof screen. A bamboo mosquito, coming across such a screen, would simply stick its head into the mesh and wriggle through, instead of futilely

Photo by Mildred J. Ericson

▲ Where a still day means quiet death: a lethal pool on the Upper Terraces at Mammoth Hot Springs, Yellowstone National Park

An INVISIBLE Deathtrap

One of the strangest perils that a bird can encounter

By Mildred J. Ericson

At Yellowstone National Park, mysteries and marvels seem to lie on every hand, but there are few things so startling as a little pool where hundreds of helpless birds meet their doom every year. The innocent-looking little depression, which we may refer to as "Poison Pool," is in the Upper Terraces of the Mammoth Hot Springs formations.

The spot is well shaded and bedded with luxuriant grass, an enticing retreat for any unwary member of the feathered clan that stops for a refreshing drink or bath. The water is safe enough to drink, but death lurks in the carbon-dioxide gas that continually bubbles to the bumping against the screen like an ordinary mosquito.

The growth rate of a larval mosquito varies greatly according to the habits of the species. Those that breed in temporary rain pools sometimes grow very fast indeed, passing from egg to adult in the three or four days that elapse before the pool dries up. Others, that live in protected situations like tree holes, may take many months to grow up.

I have often been asked, "How long does a mosquito live?" Meaning, of course, an adult mosquito. The answer is, "It depends." In Europe and North America, many kinds of mosquitoes pass the winter as adults, hibernating in outbuildings, in caves, or in tree holes. With such mosquitoes, the last blood meal of the fall turns into a fat reserve instead of into eggs, and the adults live for many months in an inactive state.

The conditions of life for such a hibernating mosquito are very different from those for an active mosquito engaged in its proper business of annoying picnic parties. The hazards of existence for an active mosquito must be tremendous, and probably few of them manage to live for more than a few days. Yet to transmit malaria or yellow fever, we know that a mosquito must live for at least a week or two, to complete the incubation period of the parasite. Since these diseases are, or have been, very common, a great many mosquitoes must survive for this incubation period.

I have often wondered how it happens that anyone ever gets malaria, considering all of the hazards of the mosquito transmission cycle. Yet we are sure that we know all of the essential facts about malaria transmission; and millions of people get the disease every year, so the system of transmission would have to be called "successful."

In the United States, to be sure, this transmission system may already have met complete defeat. At a meeting of malaria experts held late in 1949, the specialists were asked how many new cases they had seen during the year among persons living in the United States. Only four new cases were described, although of course there were numerous cases of relapses, or of infections acquired abroad. Not many years ago there were millions of new cases of malaria in the United States every year.

Thus we seem to have the basic information that is necessary for the control of the disease, and in regions with well-developed public health services, malaria is on the way to becoming a medical curiosity. In India, Africa, and much of tropical America, it is still the major human disease, but the need is mostly for expanded public health organization. But even with malaria removed from the face of the earth, mosquitoes would still be valuable and interesting subjects for study, perhaps giving us clues to the general problems that seem to be just beyond our understanding: problems of the adaptations and mutual relations of our fellow organisms, and of the method and direction of the evolution of species.

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surface. On still days the area is a vacuum of death. Since the carbon-dioxide gas is heavier than air, it then increases its concentration to such an extent that the rapid respiratory systems of its victims are overcome and they drop to a resting place on the ground.

I am certain that these birds do not always lose their lives on the first trip, because wind sometimes keeps the area well ventilated and safe. Sooner or later, however, the birds remain too long on the wrong day.

The number of victims varies according to atmospheric conditions, and the kinds that are overcome seem to depend on the concentration of the gas. On two different tours, I counted 26 birds around the pool's edge, though the daily toll is seldom this large. The birds range from a screech owl found one day, down through the small flycatchers and warblers. Songsters that met their fate here include the evening and pine grosbeaks, green-tailed towhee, western robin, pine siskin, western tanager, white-crowned and chipping sparrows, Audubon's and pileolated warblers, mountain chickadee, red-breasted nuthatch, western bluebird, hairy woodpecker, western flycatcher, and Clark's nutcracker.

No one knows how many birds die here every summer—probably hundreds. An accurate count cannot be made, because animals visit the area at night and feed upon the small feathered victims. Coyotes, martens, and weasels make this their evening dining room, and their diet depends upon nature's fickle mood. Each morning, park ranger-naturalists note that some victims of the previous day are missing and that new ones have been added.

Apparently four-footed animals are seldom if ever suffocated by the gas, presumably because they are not so susceptible to impure air. It will be recalled that canaries have long been taken into mines to detect the presence of poisonous gases. In other portions of Yellowstone Park, animals the size of bears and elk are reported to have been killed similarly, according to observations in 1888 and 1897.* However, David de L. Condon, the Chief Park Naturalist, expresses some doubt about this. He informs me that he has on three occasions visited Death Gulch, where the reports originated, to search for the carcasses of animals killed by the gases from the solfatara vents. But he never found any and is inclined to believe that adverse winter conditions may have killed the large animals found there. In fact, he thinks that the calcite springs area below Bumpus Butte might be far more dangerous than Death Gulch.

Be that as it may, "Poison Pool" takes its toll of birds whenever conditions are right, and surely it is one of the most unusual dangers that they could ever encounter.

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*Science, Feb. 15, 1889; *Science Monthly*, Feb., 1899.

IS AMERICAN INDIAN CULTURE ASIATIC?

Continued from page 351

to this question that have caused most anthropologists to think of the American Indian civilizations as having developed independently.

We must discard, first of all, the land bridges or large islands that have been supposed by some to have existed in the Pacific or Atlantic oceans and to have been routes of migration into the Americas. Geologists and oceanographers are in general agreement that the great ocean basins were never land areas—certainly not during the relatively late geologic periods of man's existence. It seems we must think of any trans-Pacific contacts as having taken place by boat.

The Polynesians in their great sailing canoes were able to cover vast areas of the Pacific and probably did, on occasion, reach American shores. However, our survey of Old and New World parallels has indicated contacts more with continental Asia than with the Pacific Islands. I doubt, therefore, that the latter should be considered as a necessary intermediate step in the diffusion or transport of cultural ideas across the Pacific.

I would look rather toward mainland southeastern Asia, where we have reason to believe that shipbuilding and navigational techniques were well advanced at an early date. Accounts from the second to the fourth centuries of our era record the existence of ships that must have been larger than those of Columbus and other early Spanish explorers, and they were sailed considerable distances, from India to Java and China. Whether or not they could have made the much longer voyages necessary to have reached American shores is another of our problems needing careful investigation.

We have been asking many questions, but that is about all we can do at the present time in regard to the problems of trans-Pacific cultural contacts. We strongly believe that the questions are valid ones and have implications of supreme importance in the scientific study of man's history. They are questions needing more consideration and discussion than have been given them in the past, but we can feel confident that unbiased investigations will lead us surely, though perhaps slowly, to reliable and fairly complete answers.

THE SIGNS COLUMBUS FOLLOWED

Continued from page 365

found at once, small pieces in the noses of Lucayan Indians, gold the Indians told them had come from the islands of the south. So south they went.

Columbus followed the gold and took the gold as a sign. But the broader spirit of the man still shows in his constant delight at the varied and beautiful colors of the coral reef fishes and in his interest in the parrots, lizards, and flowers of the islands, in coconut palms and coconut crabs. Finally he came within sight of Cuba, which he took to be Japan itself, and he resolved to go from there to the Asiatic mainland to deliver in person the Royal Letters to the Grand Khan. On the first day of November he landed, together with his company. For a full month they explored and sailed about the island finding no sophisticated civilization and little sign of gold. Gradually they came to realize that Cuba was not Japan, and Columbus looked upon it more for what it was—a large and lovely island inhabited by ignorant but gentle Indians who lived by simple methods of fishing and agriculture.

After the shipwreck, Columbus became decidedly uneasy. Martin Alonzo Pinzon had already deserted in the "Pinta" in November, and Columbus was uncertain of his own authority on the "Nina," which had Martin Alonzo's brother as captain. When the "Pinta" rejoined the "Nina" early in January, he decided the sooner they set sail for Spain the better. So the ships worked eastward along the north coast of Hispaniola, and it was during these last few days that Columbus saw the three mermaids "which rose well out of the sea . . . not so beautiful as they are painted, though to some extent they have the form of a human face." It is recorded that the Admiral had seen some previously in Guinea on the coast of Manequata, and he announced on this night, in the name of our Lord, that he would set out on his homeward voyage without any further delay whatever, for he had found what he sought.

It is difficult to say what the mermaids meant to him, though his immediate decision to sail for home suggests that they were the last straw. What he saw were the manatees or sea cows of the Caribbean Sea and great South American rivers. What he had seen off the reed-fringed tropical coast of Africa were their close cousins, the dugongs. Sea cows do look half human as they raise their head and chest out of the water to look around. They are, in fact, warm-blooded mammals that breathe air and bring forth their young alive; and the round head, the arm and hand clasping a suckling youngster to the breast, inevitably suggest the idea of mermaids.

So the two caravels set forth on the long voyage home, striking boldly to the northeast, a course that took them directly to the Azores. There is the same day-by-day record of man-o'-wars and boobies, tropic birds and weed, for the Sargasso Sea still lay between. By the end of January food was running low, and it was fortunate that the sailors caught a very large shark (probably a Basking Shark), "which was very welcome, as they now had nothing else but bread and wine, and some yams from the Indies."

Then, on the fourteenth day of February, the day before the Azores were sighted, the caravels were caught in a great storm. During the night of the thirteenth the ships had lain-to in a high and tempestuous sea, and they sailed close-reefed all the next day. Then the "Pinta" ran before the wind, and only the Admiral kept to his course. It was this storm that brought to his mind the recollection of the trees he had seen growing "even within the sea." These were the mangroves of the tropical islands, with their roots in the sea, and he interpreted their peculiar growth to mean that there could be no great storms in the countries he had discovered. At this time he had not experienced a hurricane, which mangroves withstand well.

Such were the signs. Most of them were meaningless or false, yet they served. For it is not the men of action who make the greatest discoveries. The dreamer who becomes a visionary and is stirred finally to set out in search of the Holy Grail goes farther into the unknown and returns richer than the professional, who often knows even too much to start. The signs served Christopher Columbus and upheld his faith to sail on and on into the path of the setting sun, telling him, as he himself had told the Spaniards, that India lay to the west as well as to the east. The signs also whispered to his secret heart that he would find the lost Eden, the Earthly Paradise. But that is another story.

Sequoias Colonize Britain

By John D. U. Ward

CALIFORNIA gold has made its mark on the English countryside and on thousands of parks and gardens throughout the British Isles. The search for gold took men among the Sequoias, and it was between 1846 and 1853 that seeds of both the Giant Sequoia (*Sequoia gigantea)* and the Redwood (*Sequoia sempervirens*) were sent to Britain for the first time. According to one story, the first parcel was sent in a snuff box by transcontinental Pony Express, the mail charge being $25 for 2 ounces.

There was some international disagreement about the name of the Giant Sequoia, for each country wished to honor its national hero. Americans said the tree should be Washingtonia, but the English said that in England it would be Wellingtonia—and it still is! Foresters and botanists refused to squabble: for them *Sequoia gigantea* was good enough, and the tree may now be seen nearly everywhere in Britain. Already there are specimens exceeding 125 feet in height, but unfortunately in Britain the timber is not good enough for the tree to be valuable in forestry.

The famous redwood, *Sequoia sempervirens* is less well known and less widely grown as an amenity tree, but British foresters value it much more highly. The heaviest stand of timber in all Britain is a redwood grove, not yet 100 years old. One tree, which cannot be more than 103 years old, has already exceeded 150 feet in height. As the redwood seems to grow quite as well in Britain as in California, our successors may see in Britain trees as tall as any in the world.

▲ A Giant Sequoia growing in an English garden. In the background is an incense cedar

◀ Thirty-five-year-old Big Trees in Berkshire, with a gigantic future ahead of them. Century-old Sequoias in Britain are over 125 feet tall

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species but here, again, the limits are relatively fixed for each sex.

One possible reason for the nonsurvival of a dwarf bird that might be hatched is the competition of nestlings for the food brought by their parents. An undersized individual could easily fail to receive its proper share. Something of the sort occurs among birds like the owls, where incubation may start when the first egg is laid, resulting in the hatching of the first eggs some time before the later ones. The late-hatched nestlings are, of course, behind their older brothers and sisters in growth and vigor, and in case of unfavorable conditions such as a shortage of food supply, severe storms, or other misfortunes, they often succumb while the stronger individuals survive. If they grow to maturity, however, they are as large as their nest mates. A bulky young cowbird in a nest of baby warblers gives the rightful infants little chance for survival.

"Runt" eggs are not uncommon, but they are abnormal products and probably never hatch. They appear to consist entirely of albumen and shell without the vital yolk, and hence are incapable of hatching. Even if one were to be complete, it is not at all certain that it would produce a dwarf bird.

MALE MALLARDS in flight: action photographs taken by Hugo H. Schroder at 1/1000 second

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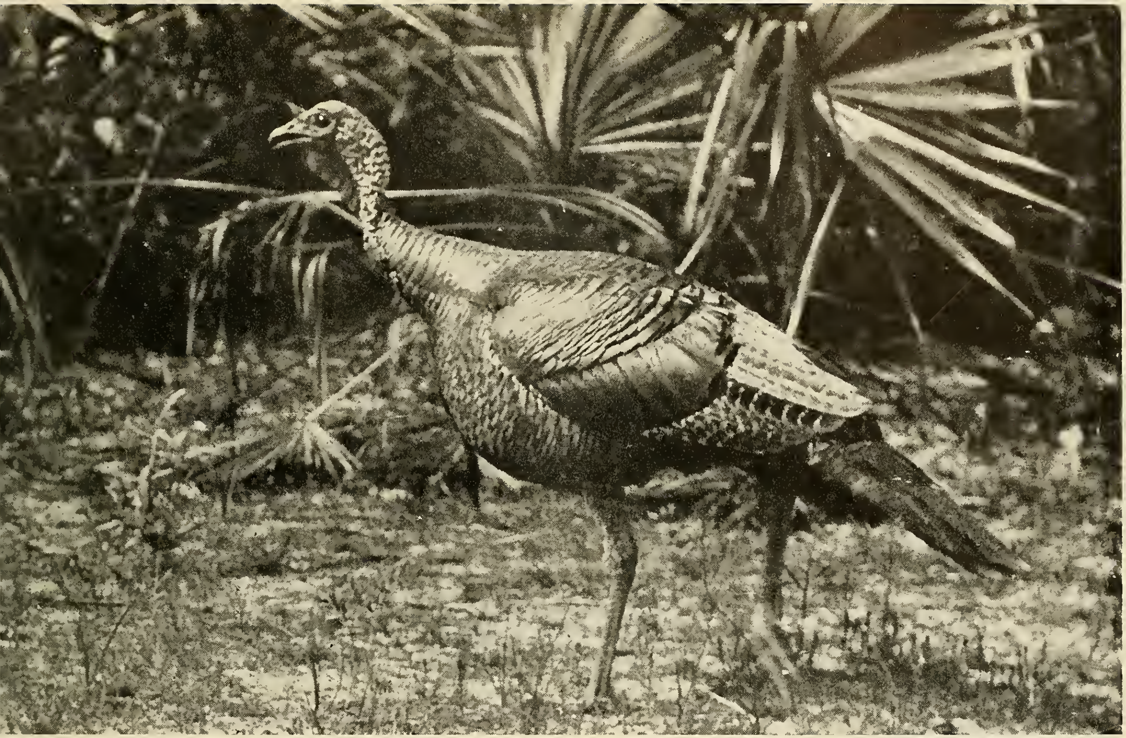


Nicholson photo, from Schroder

▲ A WILD FLORIDA TURKEY, whose "grand uncles" traveled to Europe and back to America to become the Thanksgiving Day symbol

The Turkey—a Bird with a Baffling Name

By JOHN T. ZIMMER

Curator, Department of Birds
American Museum of Natural History

WHEN the early colonists reached the eastern shores of North America, they found an abundance of one bird that they had known as a barnyard fowl in their homeland. In fact, it is quite probable that they brought some of the birds with them. This was the turkey, one of the most characteristic birds of North America and one that Benjamin Franklin later thought should be made the national emblem of the United States in place of the Bald Eagle.

The Spaniards, as early as 1517, found the turkey already domesticated by the Aztecs and took it back to Spain, from which country it was carried to other European areas. The domestic birds were somewhat different from those the English colonists found on the eastern seaboard, having the feathers of the lower back and tail tipped with white instead of rich chestnut-brown, thereby proclaiming their Mexican origin. Local birds may have been caught and tamed, and some barnyard individuals undoubtedly escaped to the woods, so the populations eventually became somewhat mixed in the neighborhood of settlements. The distinctions are still evident, however, though the wild birds have been extirpated over much of their once-extensive range. Several intermediate forms or subspecies occur in the Southwest, and still another lives in southern Florida—somewhat smaller than the northern bird with narrower barring on the wings (see illustration). Various domestic strains have been developed that differ widely from the original stock, and there is a quite distinct species in southern Mexico and adjacent countries, the handsome Ocellated Turkey.

Much has been written about this fine bird, but one question is still uncertain: Where did it get its name? One suggestion has been that it was long confused with the guinea fowl, which may have reached Europe from Africa by way of Turkey and was once known as the Turkey-cock. When the two birds were eventually recognized as distinct (their confusion seems hardly credible), the name turkey was retained for the wrong bird as, indeed, its Latin name *Meleagris* was undoubtedly misapplied. Another account credits the bird with having named itself by its repeated call of "turk-turk-turk—." Which answer is correct, if either, remains a matter for speculation.

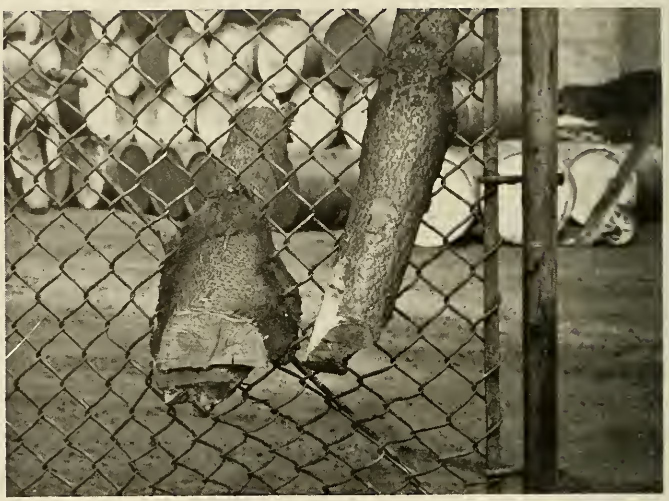
LETTERS

A Persistent Tree

Sirs:

The adjoining photograph shows what happened when a growing tree found a heavy wire gate in its path. The gate had been leaning against a fence for several years, and the tree grew up through it. New construction work made it necessary to cut down the tree, and we were interested to see that the shoots had grown directly through and around the wires, as is shown here.

H. A. Richardson
New York, N. Y.



Geese in Trees

Sirs:

An old pioneer of Clark Fork Valley told me something I could scarcely believe, though the gentleman was well reputed for his honesty. He had . . . lived in the first homestead at Clark Fork, Idaho, and had been a continuous resident of the area since 1883. He said that he had seen geese by the thousands roosting in the trees along Clark Fork River. "One day not many years ago," he told me, "when I went into a store in Hope, an old fellow had just been telling how geese roosted in the trees. No one believed him, so when I came in, he asked me to verify it. I told them that I had seen geese in the trees and that I wouldn't have believed it either if I hadn't seen them myself." My informant did not know why they did this but suggested that, since geese are smart, they may have done so to get above the ground to avoid mink and other animals that prey upon them. Sometimes, he said, they lived in eagles' nests, too. The gander would take possession of an eagle's nest and often fight for two or three days. The gander usually won out when he had plucked out enough feathers; and the eagle never seemed to return. He also said that when the goslings were hatched, the parent geese would fly down to the water with them in their beaks.

Can you give me some enlightenment on these points?

Mrs. Sunnie F. Lancaster
Opportunity, Wash.

The following remarks are offered by Dr. John T. Zimmer of the American Museum's Bird Department:

It has been reported that the Canada goose sometimes takes to the trees in certain parts of its range and on occasion makes use of the nests of some of the larger birds of prey. Osprey nests, in particular, have been spoken of in this connection. The reports have not been sufficiently numerous or detailed to mention all the kinds of nests that may have been used in this way, but I see no reason why those of the golden and bald eagle might not be on the list.

No reports have come to hand regarding conflicts between the geese and the rightful owners of the pre-empted nests. The nearest approach to information on this aspect of the situation comes in a report of an osprey nest that was found to contain two osprey eggs and three goose eggs. Ospreys and geese were both near by when the observer examined the nest and collected all but one goose egg, and they both resented the intrusion. Later, the single goose egg remained in the nest with the osprey incubating it, and the geese were nowhere to be seen. This would seem to imply that the geese had been the losers.

The Canada goose is a good fighter on the ground, but it might be at some disadvantage in a tree, even with the added foot space given by a nest platform. I am not sure that I am prepared to accept the account of a successful treetop battle with an eagle—a bird of no mean power itself, and certainly more at home in the environment. Such a conflict might possibly turn out as described, especially if the goose had already started incubation and the eagle was only preparing to occupy the nest; but it is doubtful if this is a regular occurrence.

When geese nest in trees, the young are not carried down by the parents but are pushed out of the nest to flutter down by themselves in the manner adopted by various tree-nesting ducks.

Why the birds take to the trees is not always clear, but it has been suggested that some of the localities where this occurs are subject to spring freshets that would wash away a nest placed on the ground. That is one possible answer to the question.

Stolen: One Fish

Sirs:

I have fished for brook trout for many years and fully understand the "hazards," such as trees, shrubs, grass, stumps, and wind. The following incident is something new in my experience. While Harry H. Miller of Burlington, Vermont, was fishing one evening in July at the Lake Mansfield Trout Club, he was about to net a trout, estimated by two experts to weigh ten pounds, when a barred owl swooped down and took the fish from the mouth of the net. A few feet above the water the hook was released, and the owl headed for the woods. It was known that a family of young owls lived near by, and it is assumed that the youngsters enjoyed a treat.

J. M. Hollister
Stowe, Vt.

Dr. Dean Amadon, of the American Museum's Bird Department, expresses the opinion that, though this must have been an unusually bold bird, it should not be taken as any great surprise that a Barred Owl should swoop down and seize a trout that was being netted.

"The Barred Owl," he remarks, "is more partial to swamps and tree-fringed water

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NATURAL HISTORY

The Magazine of the American Museum of Natural History

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The Prothonotary Warbler ....Cover Design
From a color photograph by W. Bryant Tyrrell

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The Prothonotary Warbler

One of the handsomest of the family of Wood Warblers is the Prothonotary Warbler, shown on this month's cover in a color photograph by W. Bryant Tyrrell. It has no striking pattern of contrasting colors like some of its relatives, but its brilliant orange-yellow head and underparts need no such enhancement. The origin of the bird's name is lost in mystery, having been given to it by Buffon in 1778 without explanation. Possibly it had some connotation of the saffron robe worn by a contemporary church or court official, but the allusion has never been traced.

The bird is a lover of swampy woodlands in the eastern United States, building its nest in hollow stubs over the water, often in the abandoned hole of the downy woodpecker or chickadee. The nests are lined with moss or other soft plant fibers. Usually from five to seven eggs are laid, of a creamy-white or buff color, heavily marked with chestnut-red or purplish spots.

The male's song is simple but loud and clear, and, in addition, he is said to have a softer utterance given only in flight during the nesting season.

John T. Zimmer

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From Newton to Einstein • Birds of Greenland
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THE EVOLUTION OF SCIENTIFIC THOUGHT FROM NEWTON TO EINSTEIN

- - - - - - - - - - - - - by A. d'Abro

Dover Publications, Inc., $3.95
481 pp., 21 figs., 15 plates

THIS book, outlining the development of thought from the theories of Newton to those of Einstein, calls for deliberate and careful reading because it epitomizes the profoundest depths of rationalization reached by man. Although the frontiers of advanced scientific thought lie beyond the perceptive powers of the average reader, the author has kept his text as simple as the subject permits and selected examples most likely to be grasped by a lay reader.

The desire of the public to venture beyond the confines of every-day thought into the mysteries of the Smyth report indicates the need for a book such as this. The more one reads along these lines, the more one marvels at the ingenuity and logic displayed by the master minds of science.

Most of our worldly affairs, and most of this generation's academic background, are conditioned upon acceptance of the theories of Euclid and of Newton. For terrestrial phenomena and for most of man's behavior these theories have worked well. For an atomic age something new has been added, and d'Abro tells us of the steps by which a select few have struck out along new lines of thought. We are told that psychologically man is incapable of grasping the full significance of some of these postulates. To that this reviewer might add that an occasional mental barrier may crop up for the average reader. But as I mounted each new theory as it broke from the corral of common experience I felt a challenge to ride it as long as possible. Intrigued by the daring departure from accepted truth, I took the curves as long as possible, and even if I was flung off into the infinite I intend to go back and start afresh from time to time.

It seems to me that this book will grow on one, that each new study will reveal things not mastered at the first reading. After all, the ideas set forth are the products of centuries of thought. How nice it is to have this boiled down in one volume.

Harold E. Anthony

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A NATURALIST IN THE GRAN CHACO

- - - - - - - Sir John Graham Kerr

Cambridge Univ. Press: London and New York, $4.50, 235 pp., 25 illusts.

IN this book John G. Kerr tells the story of his two natural history expeditions to the Paraguayan Chaco. The first trip took him in 1890 up the Bermejo and Pilcomayo Rivers—especially the latter, where he became the good friend of the "woodage" Natokoi tribe of Indians.

The second expedition (1896) led him with his close friend J. S. Badgett, up the Riacho Negro west of Concepción to a mission called Waikthlatingmayalwa, in search of the South American lungfish *Lepidosiren*. They were eminently successful and obtained *Lepidosiren* material in practically all stages of development by collecting in the deep grass swamps around the station.

The Pilcomayo expedition was much the more hazardous, partly because of continuing dissension between members of the expedition, partly because, due to the drying up of the river, boat travel was much delayed and supplies of food ran very low, and partly because, all unknown to him, Kerr was continuously stalked and watched by the Indians as he pursued his work of collecting animals and plants ashore. It was this very watching, however, that in the end assured the Indians that he was a mere naturalist and led them to give him their friendship and trust.

The book is packed with valuable but random jottings on the behavior of the animals, birds, reptiles, and amphibians seen by Kerr, virtually all referred to by their technical as well as colloquial names. This latter fact makes me wish that the author had seen fit to add a technical index, for among naturalists few know that the Indian name for the maned wolf, *Canis jubatus*, is *Aguará guazú* (index, p. 234).

The chapter on the Natokoi is particularly interesting. Kerr lived with them in their camps and was thus especially well placed to observe them.

The "60-foot poisonous serpent" *Bothrodon pridii*, with fangs (plate 8) four or five times as long as those of a rattle-

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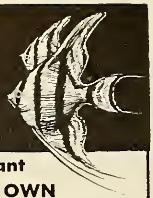

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Duff *By William Marshall Rush*	An informative story of a black bear with superb illustrations by a former member of the Museum staff. The description of the country, the details of bear life and character, as well as much humor add to the interest of this appealing story. Ages 11-15. 244 pages. *$2.25 plus .06 postage.*

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snake, is not so. C. M. Bogert, Curator of Herpetology, tells me that the tooth in question, of which there is a cast in this museum's collection, is positively not that of a reptile. It may be the tooth of some species of extinct fish.

I greatly enjoyed reading this book. It is simply told and utterly convincing. Perhaps the saddest part of it all (to a museum man) is the fact that the large collections made on the Pilcomayo and left on board the "Bolivia" to be brought out later, disappeared and were never seen again.

G. H. H. TATE

THE BIRDS OF GREENLAND

- - - - - Text by Finn Salomonsen
Drawings by Gitz-Johansen
Vol. I, Ejnar Munksgaard,
Copenhagen, Denmark, $9.00
157 pp., 17 illusts.

THIS volume of 157 pages, 17 plates, and numerous decorative drawings is the beginning of a bibliophile's treasure. It is published with the support of the Danish Government, and in sumptuousness it harks back to the lavish days of Prince Bonaparte and John Gould. There the resemblance ends, because its text is that of a modern regional survey, and its art strikes a completely new note.

The creators are both Danes who have had long experience in Greenland, and their product springs from fullness of knowledge. The artist, for example, sketched birds and landscape for seventeen years all over Denmark's vast arctic colony—sixty times larger than the home country—before he had an inkling that his work would be put to its present end.

The text appears in both Danish and English, running in parallel columns. Dr. Salomonsen, whose competent use of our idiom is already well known to his colleagues, first wrote the English account and afterwards prepared a free translation into his own tongue. The life histories, headed by the Danish, English, Eskimo, and technical names, treat the waterfowl included in this first of three volumes strictly in terms of their Greenland status. They readably cover the description, range, seasonal movements, feeding and breeding habits, and relation to the aboriginal human inhabitants, together with occasional discussion of ecological or other biological problems. Typical biographies fill (bilingually) from three to eight or ten large pages. They deserve more critical consideration than can be here allotted because of the need to discuss the illustrations.

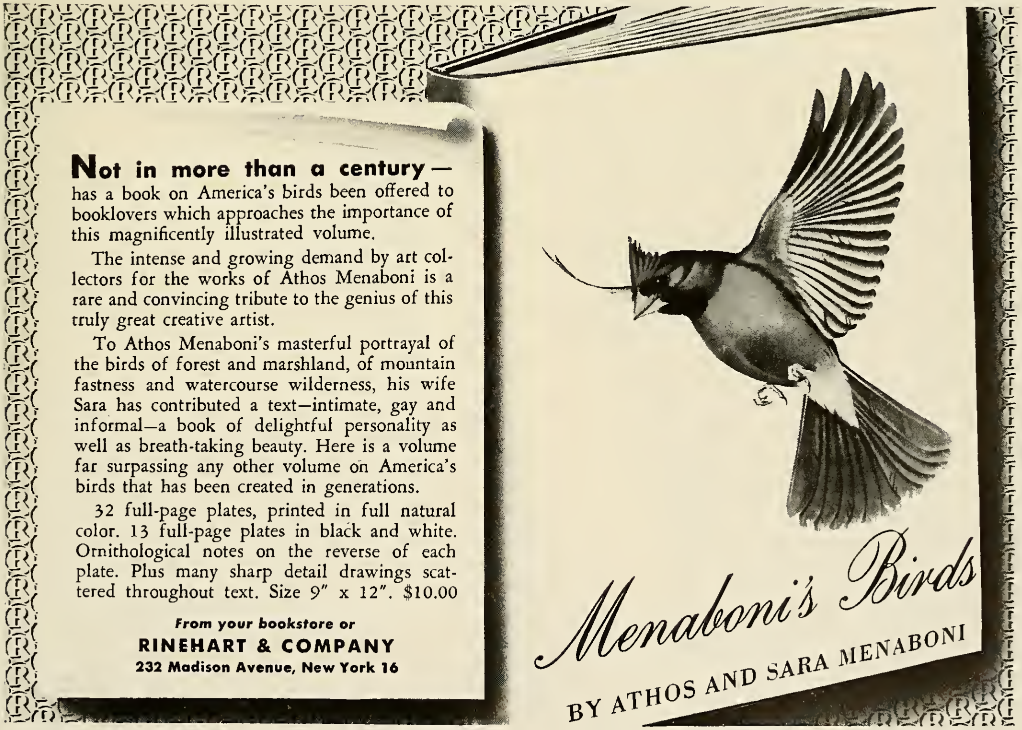
Ornithologists, whose ideas of bird portraiture are mostly conditioned to stodginess, will probably give none too warm a welcome to Mr. Gitz-Johansen's plates. Therefore, it is timely to say that they represent a noble departure from precedent.

Much more than a century ago, a genius named Audubon, who had received academic training under the French master, David, began to paint the birds of America. Since his time, most illustrators of birds have been at best content to be Audubon imitators, contributing nothing new and in countless instances departing further and further from sound canons by puddling with the muddy pigments of so-called tempora. They have produced thousands of "pretty," gutless pictures that stir no inward flame. Despite such patent degeneration, there are ornithologists who fly in the face of all adequate artistic judgment by condescendingly speaking of Audubon as "a good bird painter for his day!"

Now, Gitz-Johansen is neither Audubon nor a "me too." He has blazed his own trail in the milieu of free, clean, rich, and strong water color, and his impressions of birds will make nobody yawn. True, the plates are not all equally successful; the Greenland mallard, for instance, does not please this reviewer. But the loon, the fulmar, most of the geese, the Barrow's golden-eye, and others are magnificent. If you have any doubt about it, stack them up beside the illustrations in recent American bird books and see which portraits represent the living fowl in its ambiance of land and sea and sky.

R. C. MURPHY

Continued on page 432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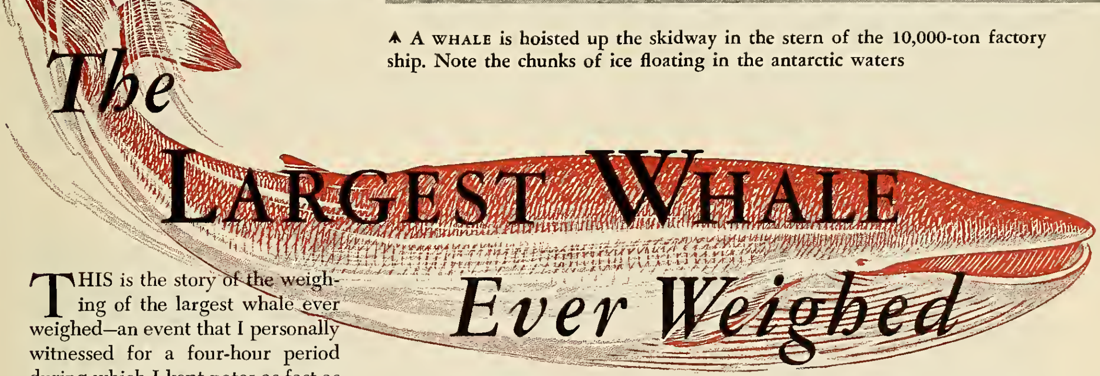
Menaboni's Birds
BY ATHOS AND SARA MENABONI

U. S. Army photo

▲ THE AUTHOR (*left*) and K. Maedo, Chief Inspector. On this unique expedition, [illegible] whales were weighed in 3 months

▲ A WHALE is hoisted up the skidway in the stern of the 10,000-ton factory ship. Note the chunks of ice floating in the antarctic waters



The LARGEST WHALE *Ever Weighed*

A thrilling whaling expedition into antarctic waters accomplishes, for the first time in history, the mammoth task of weighing on shipboard the giant among mammals

By LT. COL. WALDON C. WINSTON

Photographs by the author unless otherwise credited

THIS is the story of the weighing of the largest whale ever weighed—an event that I personally witnessed for a four-hour period during which I kept notes as fast as chilled fingers could write. It is my impression that such a laborious event has scarcely been undertaken since Jonah's time.

The First Fleet of the 1947-48 Japanese Antarctic Whaling Expedition was unique for breaking precedent and accomplishing the unusual in whaling. There was nothing outstandingly different about the appearance of the twelve-ship fleet—a factory ship, two processing ships for salting and refrigeration, two cold-storage ships, six catcher boats, and an oil tanker—totaling 45,000 tons, except that from its mast waved the International "E" (Easy Flag, modified) authorized by the Supreme Commander for Allied Powers (SCAP), General Douglas MacArthur. Beyond its own territorial waters, no other nautical flag was authorized to occupied Japan. Personnel of the First Fleet aggregated 1300 Japanese, two Allied observers, one an Australian and the other a Norwegian, plus one American, the present writer.

My presence with the expedition was the result of a latent interest in whaling. On June 21, 1947, when I learned of plans for a second post-surrender whaling expedition for Japan, I volunteered as General MacArthur's personal representative in charge of the First Fleet. I was a member of the Natural Resources Section, GHQ. My qualifications were that I volunteered "irrevocably."

My job was to observe Japanese compliance with International Whaling Regulations and directives

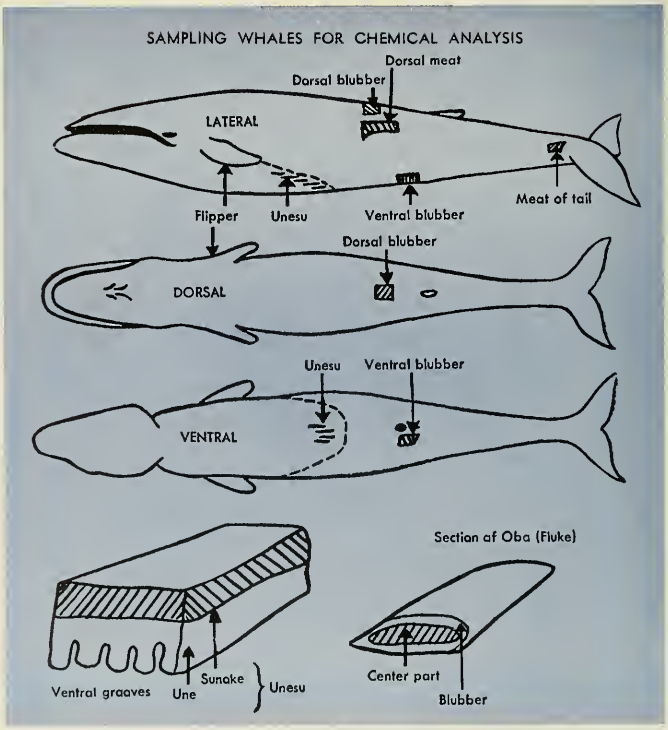
◀ THE THREE-TON TONGUE (seen from overhead) is being cut away from the twenty-three-foot lower jawbone. What appears to be hairlike growth is actually whalebone plates, which serve as a sieve. Scattered on the plates are part of an unswallowed meal of "krill," a small shrimp (*Euphausia superba*)

WORKMEN STAND about an 80-foot blue whale caught in he Ross Sea about 250 miles from Little America. The whale has been turned on its belly, giving a clear view of its scooplike mouth and of the lower jaw, which juts out beyond the snout

issued by SCAP and to ensure efficiency of operation.

For the first time in my life, I read *Moby Dick* and any other books I could find on whaling. Before leaving Osaka I learned from Japanese biologists, whaling company officials, and experienced whalers that never in the history of whaling had a whale been weighed aboard ship. I resolved that we should accomplish this, and we did so, not once but 27 times during three months of actual operation in the fog-bound, iceberg-infested waters of the Antarctic Basin and the Ross Sea.

Our 6000-mile route to the whaling grounds reversed the island-stepping approach to Japan that led up to V-J Day. Soon after leaving Japan, bloody Iwo appeared off our port, followed by Saipan, Truk, Bougainville, New Britain, and the Coral Sea. We then cruised off the east coast of Australia and into the Tasman Sea and Indian Ocean, and entered the whaling grounds near the Balleny Islands. On the 5th



SAMPLING WHALES FOR CHEMICAL ANALYSIS

Dorsal meat
Dorsal blubber
LATERAL
Flipper
Unesu
Ventral blubber
Meat of tail
Dorsal blubber
DORSAL
Unesu
Ventral blubber
VENTRAL
Section of Oba (Fluke)
Ventral grooves
Une
Sunoke
Unesu
Center part
Blubber

of December we killed two sperm whales.

The antarctic season on blue and finback whales, in which we were most interested for their meat and oil, began on December 8. Our hunting took us across the Antarctic Circle several times and into the Ross Sea just off the coast of Antarctica. At one time we were only 250 miles from Little America.

On several occasions I had discussed with Mr. Y. Ogino, the factory manager, my desire to weigh large whales. I informed him that few whales had ever been weighed, and that I was sure we had already processed several that would have outweighed the largest weighed whale on record.

He readily agreed that we would weigh all whales 85 feet and over—to try for a new weighing record. Meanwhile, we conducted numerous other tests.

During the lonely months at sea, I personally investigated many phases of the operation. Japanese officials, inspectors, chemists, and biologists were encouraged to conduct research along lines in which they seemed to have a paucity of knowledge. In a certain sense the factory ship of my fleet, "Hashidate Maru," became a "floating university." Let us hope that our findings on the weights of whales will add something worth-while to the store of knowledge accumulated by others.

From a study of *Discovery Reports* and other scientific books, I had found that the first blue whale had been weighed in 1903 in Newfoundland by Dr. F. A. Lucas, late Director of the American Museum of Natural History. This blue whale, 77 feet (23.72 meters) in length, yielded the following figures:

Flesh	40 tons
Blubber	8 tons
Bones	8 tons
Blood Viscera Baleen	7 tons
Total	63 tons

Captain Sorlle at Stromness, South Georgia, recorded the weights of two blue whales, which were dismembered and weighed piecemeal. The smaller, 66 feet (20.30 meters), weighed 107,812 pounds (48,903 kilograms). The larger, 89 feet (27.18 meters), weighed 268,970 pounds (122,004 kilograms), including 17,637 pounds (8000 kilograms) estimated for blood. The biggest dorsal vertebra weighed 529 pounds (240 kilograms).

Dense fog beset us in the iceberg-infested waters in the vicinity of the Balleny Islands. All ships of the fleet, widely dispersed, had drifted to avoid collision with each other or against the gigantic bergs common to that area. Although we had radar, the Japanese skippers were a cautious lot and were reluctant to move unless they had 1000 yards of visibility.

Shortly after noon on January 27, 1948, with slight clearing of the fog, limited searching and hunting oper-

STATISTICS ON THE LARGEST WHALE EVER WEIGHED

MEASUREMENT OF EXTERNAL PROPORTIONS

Date	27 Jan. 48	BLUE WHALE
Serial No.	319	
Sex	Female	

	FT.	IN.
1. Total length	89	—
2. Flipper to flipper across the back	9	6
3. Circumference, opposite tips of flippers	43	6
4. Flukes, from tip to tip	19	10
5. Length of lower jawbone	22	10
6. Tip of snout to: Blowhole	17	1
7. Center of eye	18	—
8. Tip of flipper	38	6
9. Ear to eye, center	4	7
10. Notch of flukes to posterior emargination of dorsal fin	20	—
11. Flukes, width at insertion	4	8
12. Notch of flukes to: Anus	23	7
13. Umbilicus	36	9
14. End of Ventral grooves	35	3
15. Anus to reproductive aperture, center	2	5
16. Dorsal fin: Vertical height	1	3
17. Length of base	4	5
18. Flipper: Tip to axilla	9	2
19. Tip to anterior end of lower border	12	10
20. Along curve of lower border	13	5
21. Greatest width	3	9
22. Head length	22	8
23. Skull, width	10	—
24. Skull, length	22	5
25. Tail depth opposite dorsal fin	8	2
26. Whalebone, plate length	3	8
Palate stripped from mouth	19	11

WEIGHT OF DIFFERENT PARTS (Metric Tons)

BLUBBER	
Ventral	4.13
Dorsal	10.11
Jaw	2.58
Head	2.70
Baleen roots	.45
Total	19.97
VENTRAL GROOVES	11.94
BONE	
Vertebrae	7.32
Skull	4.61
Vomer (1)	0.27
Jaw	1.99
Ribs	1.47
Flipper	1.40
Shoulder	0.40
Flukes	0.90
Hyoid (2)	0.08
Waste	0.15
Total	18.59
OTHERS	
Baleen	1.08
Tongue	3.09
"ABA" (3)	1.04
Ovary	0.004
Blood (est)	8.856
Total	14.070

MEAT	
Dorsal	23.06
Ventral	15.99
Chest	4.32
Rib	3.11
Fin	1.17
Shoulder	0.75
Internal	0.73
Head	1.90
Dendo (4)	.39
*Toji (5)	.37
Other	9.44
Total	61.43
INTERNAL ORGANS	
Fat	4.47
Stomach	0.47
Intestines:	
Small	1.23
Large	0.26
Kidney	0.36
Heart	0.43
Lungs	1.09
Liver	1.00
Carotid artery	0.15
Uterus	0.61
Bladder	0.33
Total	10.40

GRAND TOTAL	136.40

WHALE PRODUCTS

	Raw Material	Shrinkage %	Finished Product
Frozen Products:			
Red meat	None		
Ovaries	.004	None	.004
Baleen	.25	40	.15
Salted Products:			
Red meat	51.03	40	30.618
Flukes	.90	20	.720
Dendo	.59	20	.472
Vomer	.27	20	.216
Une (6)	8.67	20	6.936
Intestines:			
Small	1.23	40	.738
Large	.26	40	.156
Heart	.43	40	.258
Kidney	.36	40	.216
TOTALS	63.994		40.484

OIL PRODUCTION (Metric Tons)

#1 Kverner Boiler	
Ventral grooves	3.27
Tongue	3.09
Toji (5)	0.37
Fat of red meat	9.44
"ABA" (3)	1.04
Gross weight	17.21
Cooking time	4:00
Oil produced	6.3
Per cent	37%
Acid value	0.86
Color:	
Red	6
Yellow	10

#3 Kverner Boiler	
Internal Organs	
Fat	4.47
Carotid artery	0.15
Stomach	0.47
Lungs	1.09
Bladder	0.33
Uterus	0.61
Gross weight	7.12
Cooking time	4:00
Oil produced	2.6
Per cent	37%
Acid value	0.79
Color:	
Red	6
Yellow	10

#4 Kverner Boiler	
Vertebrae	
Gross weight	7.32
Cooking time	3:35
Oil produced	1.5
Per cent	20%
Acid value	0.69
Color:	
Red	6
Yellow	9

#2 Kverner Boiler	
Bones	
Skull	4.61
Jaw	1.99
Ribs	1.47
Flipper	1.40
Shoulder	0.40
Hyoid (2)	0.08
Waste	0.15
Gross weight	10.10
Cooking time	4:00
Oil produced	1.8
Per cent	18%
Acid value	0.74
Color:	
Red	6
Yellow	9

Hartman Boiler	
Blubber	
Ventral	4.13
Dorsal	10.11
Jaw	2.58
Baleen roots	0.45
Head	2.70
Gross weight	19.97
Cooking time	3:00
No. of fillings	9
Oil produced	10.3
Per cent	52%
Acid value	0.70
Color:	
Red	6
Yellow	9

WHALE OIL GRAND TOTAL	22.5
CRUDE LIVER OIL (International unit—110,000)	37Kg.

TOTAL TIME REQUIRED

Measuring	:30
Flensing Dismembering Weighing	3:45
Total Elapsed Time	4:15
Processing Plant Hours	
#1 Kverner Boiler	4:00
#2 " "	4:00
#3 " "	4:00
#4 " "	3:35
Hartman Boiler	3:00
Grand Total Elapsed Time	8:15
Number of men Employed	105
Total Man-hours	546

REMARKS

Color:
Lighter the whale oil the higher the grade. First grade pale yellow; lower grades shade to brown.

All meat possible was cut from bones and vertebrae.

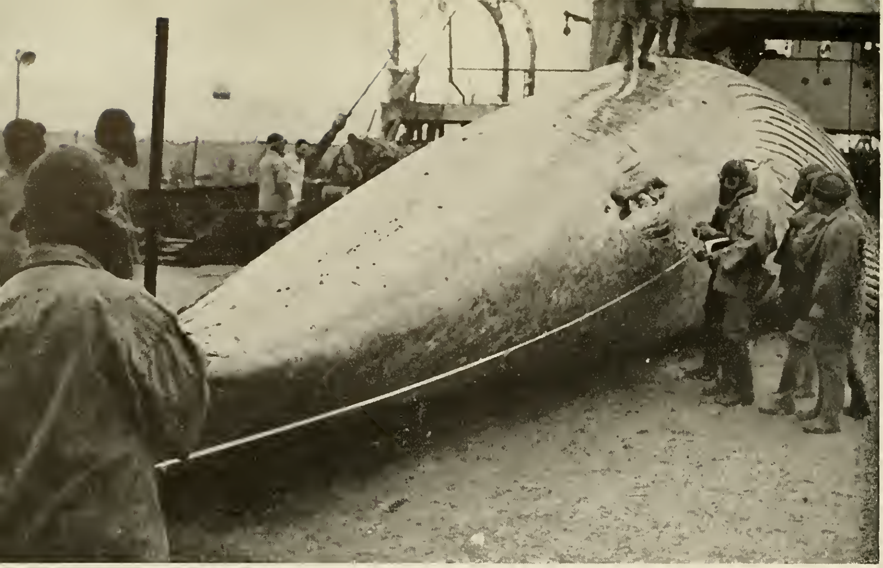
NOTE:

Clinometer (Maximum) during weighing period:

Port	1.5°
Starboard	1.0°

FOOTNOTES

(1) Vomer—Softbone of nose
(2) Hyoid—Throat Bone
(3) "ABA"—Mucous Membrane
(4) Dendo—Fluke Tips
(5) Toji—Jaw Muscle
(6) Une—Fat of Ventral Groove (Belly Blubber)
*Processed for oil



▲ **Measuring the notch** of the flukes on the female blue whale. Never before in the history of whaling had a whale been weighed aboard ship

ations were resumed. At 1410*, "Kyo Maru No. 6" had fastened to a large blue whale. From the bridge of the 10,000-ton factory ship, "Hashidate Maru," we could see the catcher boat silhouetted against the horizon, creeping after her game like a fisherman playing a fighting pike, keeping a tight line, reeling in with huge winches.

Presently from my position on the bridge I observed "Kyo Maru No. 6" drawing its game alongside to be inflated and towed, tailfirst, to the factory ship. A radio message to the factory ship reported that Whale No. 319 had been killed at 1610 and was estimated to be 84 feet in length. I had noted a tendency on the part of gunners to overestimate the small whales and to underestimate the large ones. For this reason I felt sure the whale would be over 85 feet.

I asked the Japanese officials to change plans and prepare for other tests if No. 319 proved to be over 85 feet. This was agreeable to all. As the whale came up the skidway I knew we had a very large whale, but it looked lean to me. Unfortunately, I was right.

The description that follows is summarized from my personal notes taken on the flensing deck as the largest weighed whale in the world was processed.

Ship's Log—27 January 1948

1600 Gentle breeze and misty weather, sea slight.

1635 Received blue whale from "No. 6 Kyo Maru."

At 1705, Blue Whale, female, No. 319 was received on the flensing deck.

Commander Herman K. Sundt, Norwegian Observer, was at the stern with me as the whale, a female, was hoisted aboard. Both of us agreed it was over 85 feet in length, and when it came to rest on the flensing deck we hung expectantly over the inspector's steel tape to verify for ourselves the measured length. It was—glory be—89 feet!

Word passed rapidly among the men, and they knew it would be carefully measured by the biologist and inspector and weighed part by part. The workmen gathered around the gigantic mammal in awe. The huge teats were the size of loaves of bread. The Chief Inspector clambered up the steep ventral grooves and bulging side as if hill climbing. When the outside measurements were finished, the flensers got the signal and the hard work started.

For four hours, I was treated to a kaleidoscopic scene that challenges description. The flensing operation

CHEMICAL ANALYSES
ON
DIFFERENT PARTS OF WHALES

Whale Serial No. 319
Species: Blue (89 ft.)
Sex: Female
Fatness: L
Freshness: 95%

Date of Killing: Jan. 27, 1948
Date of Examination: Feb. 5, 1948
Place of Killing: Lat. 64–36'S
Long. 163–17'E

Parts of Whale	*Water*	*Crude Fat*	*Solids*	*Remarks*
Blubber	25.4%	61.2%	13.4%	(Proportion of dorsal & ventral blubber is 2.1)
Une	25.7	56.8	17.5	
Meat of Tail	58.6	25.5	15.9	
Dorsal Meat	75.0	3.4	21.6	(Below dorsal fin)
Lung	81.3	1.2	17.5	
Heart	76.4	0.7	22.9	
Dendo	69.9	0.3	29.8	
Flipper (center part)	55.9	13.8	30.3	
Oba (center part)	51.5	12.4	36.1	
Oba (blubber)	56.4	6.3	37.3	
Carotid Artery	74.4	0.3	25.3	
Head Bone	22.9	42.2	34.9	
Thoracic Vertebrae	26.0	21.5	52.5	(8th bone)
Lumber Vertebrae	18.0	48.2	33.8	(11th bone)
Vertebrae	8.9	44.0	47.1	(7th bone)
Jawbone	10.8	36.8	52.4	
Rib	20.2	21.6	58.2	(8th rib middle section)
Vomer	68.8	0.4	30.8	

progressed with assembly-line precision, beginning with removal of the huge tail flukes, which measured 20 feet from tip to tip. Numerous workmen swarmed about the 100-meter flensing deck, busily engaged in the tasks of flensing, dismembering, and weighing, while others between decks supervised the processing activities. A whale is usually on its side when hoisted upon the flensing deck. Longitudinal cuts are made through blubber from tail to head, then huge strips of ventral and dorsal blubber are removed in that order. This operation is accomplished by the use of small winches conveniently placed about the deck, while the workmen

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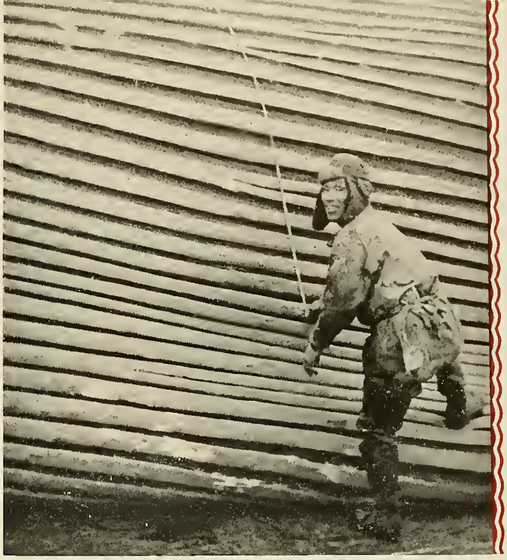
*Time of day is indicated here by the 24-hour clock, in which 1410 signifies 2:10 P.M.

▲ **It required** 80 men 3 hours and 45 minutes to flense, dismember, and weigh this 89-foot blue whale



▲ **With steel tape** these men are measuring the circumference of the blue whale. During the many phases of the gigantic weighing operation, anatomical analyses were made that should contribute to the knowledge of this largest of all mammals

hack at the connective tissues with long-bladed flensing knives.

The rubbery three-ton tongue and ventral grooves came next. Huge 11½-ton loins of rich, red meat peeled from the carcass ahead of spareribs weighing about 1.4 tons. A great mass of internal organs, weighing about 10 tons, spilled from the abdominal cavity. Flank blubber, meat, and ribs pinned on the underside were stripped off in order as the mammoth head was severed from the backbone.

All that remained was the job of separating the vertebrae, joint by joint. Blubber was stripped from the huge snout, and the 23-foot jawbones were severed from the skull.

By the time the whalebone, or baleen, was stripped from the roof of the mouth, the flensing and dismembering operation had reduced the erstwhile monster of the deep to a stack of blubber, bones, and meat.

Dodging chunks of blubber and meat as they were shunted about the deck for different phases of weighing and processing, I seemed to be at the hub of activity amidship near the winch deck. Mr. Ogino, the factory manager, stopped to inform me that the fluke tips had been cut off by the catcher boat to reduce resistance in towing but that they would be brought to the factory ship for measurement. As great blankets of blubber were ripped from the carcass, Keijiro Maeda, Chief Inspector, remarked, "This whale no fatness," and we put down "L" for lean.

"Yes. Very sorry, because I had hoped for a fat one this time," I responded as he moved forward.

At the loading chute and three other points on the deck, the most important activity of the whole operation was progressing. They were weighing chunks of blubber, meat, and bone cut into 40- to 50-pound pieces on small platform scales such as one finds in a feed store. Imagine weighing a herd of cattle, piece by piece, across scales unable to handle more than about 200 pounds at a time. This is how we weighed the largest weighed whale in the world, totaling approximately 300,000 pounds!

Workmen laughed and leaped aboard loins that were skidding forward to the loading chute. Others there started a chanty. Everyone seemed happy. Over and over, they filled the box on the small platform scales, then emptied the contents down the loading chute.

The rattle of winches was continuous as cablemen ran about the deck following their systematic plan of dissection. Small, two-man bone saws with link chain blades were used to cut up the smaller bones.

Hayashi, the biologist, and a chemist moved about the deck selecting various samples for later analysis and study. The ship's doctor and an assistant examined the rotund chin from which whiskers had already been plucked. From past experience I had found that most of them break off at the roots. Whale whiskers are very brittle.

The biologist cut into the huge stomach to examine its contents. Baleen whales feed upon small shrimps, referred to among whalers as "krill," which are found in great swarms along the edge of the ice pack. The species and quantity of shrimps found in the stomach and the degree of digestion were noted by the biologist.

A furtive movement at my flank caught my eye. A silent workman was tearing by hand the covering from the 950-pound heart. Fearfully, he glanced at me as if I might take from him a prize of great value. His dogged determination as he flaked fat from the covering held my attention. The chemist, observing my interest, informed me that the

▲ A TYPICAL ANTARCTIC scene, as seen from the factory ship. All the ships in the fleet were widely dispersed, to avoid collision with each other and with the gigantic icebergs

covering can be processed for a drumhead – Buddhist style. The worker looked at me less fearfully now and by gesture indicated beating of a drum. "Heart covering usually very thin," continued the chemist, "this very thick." I fingered the covering and found it thick as buckskin.

While I was standing on a twelve-inch ledge near the blacksmith shop, a chunk of head meat – nearly half a ton – came sliding across the deck, splattering my clothing and notebook. The cableman looked up at me apologetically as if expecting some critical or derisive remark. I laughed. How could anyone expect to move freely about a flensing deck without getting his clothes dirty! Had the ledge not been there, however, one can hardly say what might have happened.

The factory ship was equipped with six Kverner boilers (twenty-ton capacity) for processing oil from blubber, bones, and meat, and one Hartman boiler (ten-ton capacity) exclusively for processing oil from blubber. There were also settling tanks, centrifugal separators, storage tanks, and a complete plant for processing crude vitamin oil from the one-ton whale livers.

For three years I have worried about my ability to put into words what I saw and felt about this strangest experience of my life. I always want to take everyone by the hand and lead them through each interesting detail. Many have patiently endured this explanation, but I can't say they would care for a repeat performance.

Mealtime had passed by more than an hour when I moved toward the boat deck and my cabin.

"You missed your meal," observed Kenneth Coonan, Australian Observer, as I approached.

"Yes, but I've been waiting for this all season. I can eat any time," I replied, still excited over the spectacle. I continued with my notes as he gazed curiously out upon the mass of blubber, bones, and blood. My hands were so cold from writing barehanded that I had to stop and rub them vigorously to bring back the circulation.

A finback whale was brought upon the deck as I finished eating. I hurried out to delay flensing operations until the deck was completely clean. Number 319 had been brought upon a clean deck, and I wanted it clean before another whale was flensed. This way I could vouch for the weight of the whale. "Saito! Saito!" Where was my interpreter? Returning inside I found Yamagami, my photographer, and sent him for Saito. Impatiently I waited for him to appear. Briefly, I explained why they must wait before flensing another whale, and he hurried off to see Yuge, the chief of the flensing operation. That was settled!

The deck was clearing fast. The last big section of vertebrae was dropped into No. 4 Kverner boiler, and the men who hooked it in followed it with their eyes as it plunged into the heap of bones and meat below. They looked at each other and laughed as if congratulating themselves that it had not stuck in the opening, from which they sometimes had to probe huge bones with a long iron bar. Two boilermen appeared and began to close the door and to put on the cover before steam at 60 pounds per square inch could be applied.

No. 3 and 4 Kverners were soon closed, and the rib sections moved across the deck to No. 2. Most of the 61½ tons of meat had disappeared down the loading chute, and men were cleaning up around the bone saws to collect flakes and scobs of bone torn out by the heavy-bladed saws.

The chief of the flensing section, Yuge, laughed good-naturedly and spoke to Saito. I looked inquiringly his way and Saito explained, "He says that in seven seasons in the arctic and antarctic this is first time he has ever seen a Japanese factory ship processing a whale this way."

"You can tell him that this procedure has probably never been followed before on any whaling factory ship in the world," I replied.

Covers had been placed on No. 1 Kverner boiler containing ventral grooves, tongue, *toji* (jaw muscle), fat of red meat, and *aba* (mucous membrane). The last ribs were dropped into No. 2. The boilermen let themselves down into the two-deck opening to close the doors of the great boilers, containing over ten tons of raw material. This boiler will hold nearly twenty tons of meat and blubber, but we put only bone in No. 2 in order to determine the percentage of oil produced by actual processing.

It had required the efforts of 80 men about 3 hours and 45 minutes to flense, dismember, and weigh, part by part, this largest whale ever weighed. Twenty-five more were working below in the processing section.

Through binoculars, I had watched "No. 6 Kyo Maru," only a few miles distant from the ship, when she secured this whale. It must have been only a few minutes after the whale was harpooned, because I could see the harpoon line hanging down from the bow and finally the slow roll of the animal as it was brought along from the bow and secured to the catcher boat for towing tailfirst to the factory ship.

Later, Sutekichi Kikuchi, the gunner, told me that firing the final harpoon into the huge creature had been difficult because each time the catcher boat drew the animal within range, it would dive. For two hours the struggle continued until finally the *coup de grâce* could be administered, and the spirit of the huge leviathan, "Kujira Kuyo," was released to rove restlessly in space until, reconciled for its untimely demise by the annual Buddhist ceremony "Kujiro No Kuyo," it could journey into whale heaven and become Buddha.

It was possible to weigh this whale on regular platform scales because the ship was stabilized by 600 tons of sand ballast. The roll of the ship averaged an arc of less than two degrees on the clinometer during the flensing, dismembering, and weighing, because there was only a slight sea at the time. A test observation revealed maximum roll to be one degree starboard and one and one half degrees port.

When weights of blubber, bones, meat, internal organs, and other parts were added up, we had an actual weight of parts of 281,087 pounds, or 127.5 metric tons.* Estimating the blood and stomach contents at about 19,500 pounds (8.856 metric tons), Blue Whale No. 319 weighed approximately 136.4 metric tons, or 300,707 pounds!

Whale oil produced was 22.5 metric tons (133 barrels), valued in 1948 at approximately $440 per ton, or $9,900. Red meat stripped from the body weighed 61.4 metric tons. Allowing for shrinkage, frozen and salted products totaled 40.484 metric tons. The meat products were valued at approximately $18,000. The total value of all products exceeded $27,900 from this one whale carcass. Without shrinkage from salting, it would have been more. You will notice that the meat, which is often considered of no importance, was actually worth about twice as much as the oil.

Upon our arrival at Osaka, the Japanese lost no time in announcing in their *Shimbun* (newspapers) their accomplishment in weighing the largest weighed whale in the world. Apparently this "scooped" all Allied newspapers. I had received confirmation on previous whale weights from the International Bureau of Whaling Statistics, Norway, a few days prior to landing and so informed the Japanese. I thought it was a "scoop" accomplishment myself, but others were slow to share my enthusiasm. Larger and heavier whales were caught by the expedition, but they were not officially weighed and recorded. The First Fleet had weighed 27 whales (16 blue and 11 finback) and recorded them—a record-shattering event on any whaler's logbook!

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*A metric ton is 1000 kilograms, or 2204.6 pounds.

Chunks of blubber, meat, and bones, cut into 40- to 50-ound pieces, are weighed. The four small scales that were used vere unable to handle more than 200 pounds at a time

▼ Measuring the surface area of the whale was a laborious task accomplished by Biologist T. Hayashi (*left*). K. Maedo assists, as the author looks on

U. S. Army p

Tiger

# of the Grass Roots

The short-tailed shrew has an appetite for twice its weight daily and carries poison enough to kill 200 mice

By Tom McHugh

Photographs by the author

"It is a ravening beast that biteth deep and poysoneth deadly," wrote one 17th century naturalist. He was not describing some prehistoric monster. He was referring to a very tiny, sharp-nosed creature called a shrew, which at that time was feared as much as a viper.

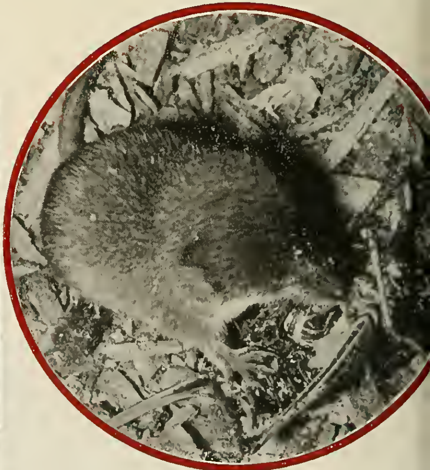
But those beliefs were soon put in the class of quaint folklore; and when the science of bacteriology was born, it was said that shrews were no more poisonous than a common house mouse—the danger was simply from infection. But this reasoning broke down in 1889.

In that year a Mr. C. J. Maynard was accidentally bitten by a shrew. The skin on his fingers was punctured scarcely enough to draw blood, yet within 30 seconds a burning sensation shot up his arm and the area began to swell rapidly. Shooting pains lasted for a week, and the swelling did not go down for nearly two weeks. Here was something quicker than bacteria!

After hearing what happened to Maynard, Dr. Oliver Pearson got busy on the case. In the salivary gland of the short-tailed shrew he found a unique type of granule. When he injected saliva from this gland into mice he found it to be quite poisonous. It quickly brought on paralysis in the hind legs, labored breathing, and bulging eyes. The mice died in as little as three minutes, in a series of violent convulsions. The effects of this venom show that it is quite similar to the nerve poison of the deadly cobra. The glands of a single shrew have enough doses of it to kill 200 mice!

The shrew knows just how to use it to best advantage: Observers have noted how the short-tailed shrew bites mice through the skull—the very place where a nerve poison could act most rapidly. If the poison does not kill the mouse, it will render it so sluggish that the shrew has the upper hand in any battle.

▼ THE SHORT-TAILED SHREW (*Blarina brevicauda*) in a defensive pose. So rapid were the animal's movements that the picture had to be taken with speedlight, at about 1/10,000 of a second



▲ THE VICTIM: a field mouse, destructive to farm crops, short-tailed shrews help to reduce high numbers of these animals

This midget of the grass roots then turns out to be quite a package of dynamite. It is a beast with a bite like that of a weak cobra, an appetite of as much as twice its own weight in meat each day, and the power to whip an animal three times its size.

At the same time, there is no reason to fear the shrew. You will ordinarily have difficulty in getting close to one, and many scientists have handled dozens of them without being injured in any way. Actually, they are of great benefit, because they can eat their weight in insects each day, and they keep mice in check.

The startling thing about these animals is their small size. The body of the common type is only about two inches long. And I say "common" with reason—they are all around us. You or I never see them because they scurry through small tunnels under logs or leaves. But they are there, nevertheless. In the woods and fields, right up to the very edges of the city, and even in some vacant lots, they abound wherever there is cover and food.

Food for shrews is usually snails, insects and earthworms, but it may include almost anything that moves. For their size, they are the most bloodthirsty and ferocious creatures alive; they love nothing better than using their sharp teeth on a living victim. One scientist was foolish enough to put three shrews together in the same cage. A few hours later he found only one shrew left—one shrew with a very fat stomach.

A shrew loves to dine on a mouse, even though the victim is twice his size. When he tackles a mouse, a gory drama unfolds, a battle as furious as a grizzly's attack on an elk reduced to a Tom Thumb scale.

As soon as the shrew gets the scent, he gives quick chase and seizes the mouse's tail in his teeth. The mouse tries to flee and drags the shrew along behind in cave-man style. Then the shrew makes another lunge and grabs the mouse around the belly, rolling over and over with it in a mad melee of biting. By this time the poison is slowly taking effect, and the mouse is becoming more sluggish by the minute. The exhausted prey frees itself only momentarily, for next the shrew has it by the ear and starts to munch on that tender item. Again the mouse tears loose, and again it is seized by its foe, this time in the final death struggle. The shrew's battle is won when he crunches through the skull and begins eating his dessert first—mouse brains. The whole tragedy may take as little as ten minutes.

▲ Shrews are the smallest mammals. This common shrew (*Sorex cinereus*) weighed about as much as a five-cent piece

This particular battle was watched in a cage when the two opponents were placed together, but the same thing happens in the wild. One shrew was caught in the act of chasing a field mouse through its tunnel. It unwittingly chased its prey right into a mousetrap set by a mammalogist. The trap caught the shrew by the neck and the mouse by the hips—a perfect "Exhibit A" to prove the chase.

These depredations of shrews on mice occur regularly and make the shrew a very beneficial animal. Professor W. Robert Eadie investigated the winter nests of short-tailed shrews and found that many were feeding on field mice. When the shrews were at the height of their mouse-eating activity, the field mouse population in the area dropped from 80 per acre to 12 per acre. Professor Eadie figures that shrews might have accounted for at least 14 of these mice in each acre, and he adds that circumstantial evidence points to a higher figure.

Whether it be mice or snakes, the fearlessness of a shrew is incredible. One man placed a two-foot water snake and a short-tailed shrew in the same box. The snake was quite lively when placed in the cage in the afternoon and bit at everything within reach. The next morning, streaks on the glass sides of his prison documented his efforts to escape. He was then lying on the floor exhausted, while the shrew was busy tearing out his jaw muscles.

The poison obviously aids the shrew in its never-ending search for food; for above all, this pugnacious assassin is a slave to its stomach. Very seldom does it rest. Perhaps that is why death from old age comes at but 14 months.

▲ **Some** of the older egrets were huddled like statues on the tips of the cactus-like euphorbias

Egrets—The Hard Way

By Russell Barnett Aitken

Photographs by the author

▲ The author in egret territory. The birds decorated the trees like Christmas tree ornaments, and their chattering was incessant

What started out as a simple bird-watching trip in Natal proved to be a perilous pastime when rains trapped the author in Zulu territory

READING a newspaper in a New York taxicab is one thing, and trying it in a bouncing rickshaw in southeastern Africa is something else again.

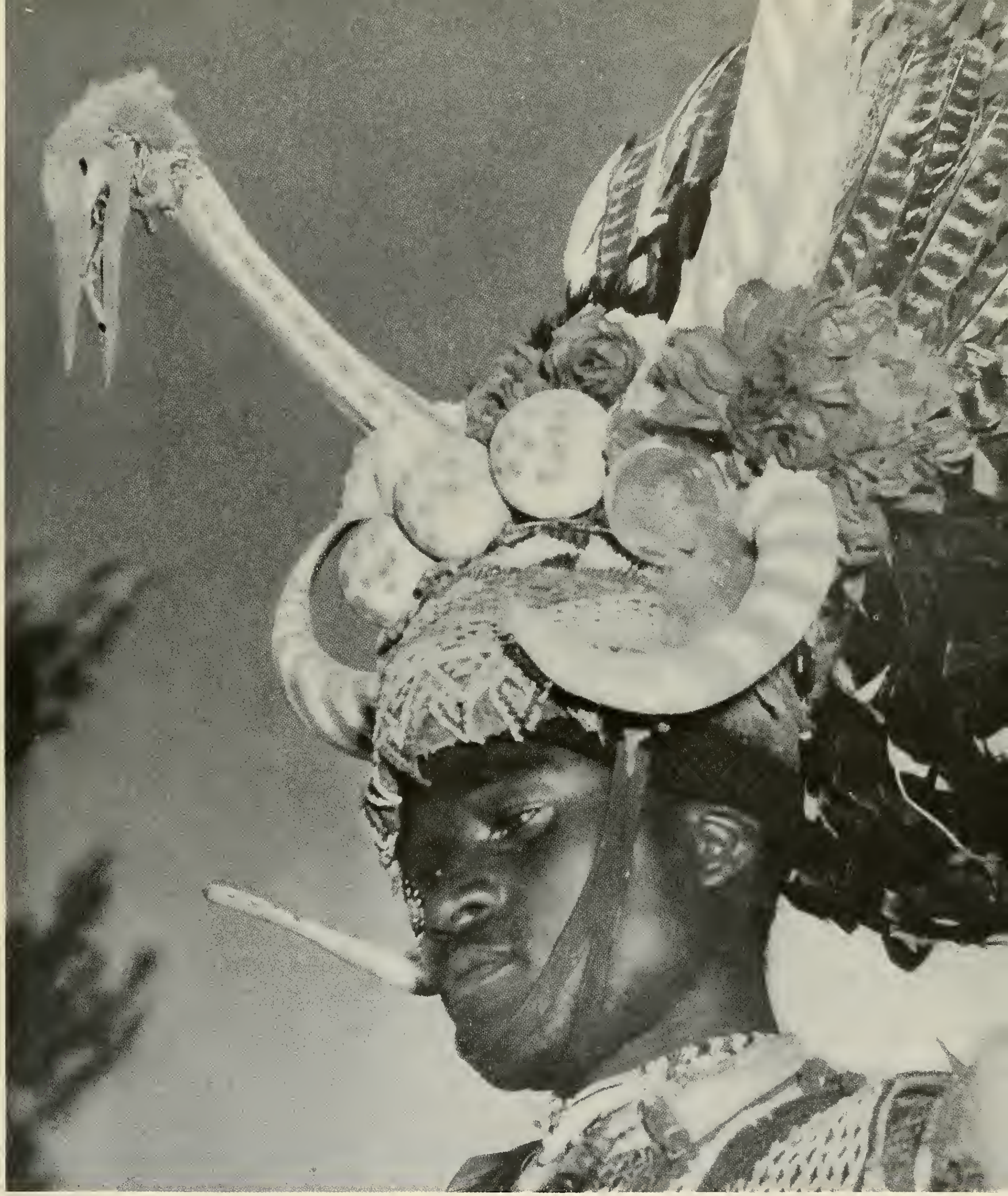
A carved wooden bird on the big Zulu's headdress bobbed blithely as he hauled me over the cobblestones of the quay toward the Marine Parade, his skin glistening like polished leather. In a tattoo synchronized with the rollicking rhythm of a lusty barcarole, the steaming pavement resounded to the padding of his naked feet. When I recognized a few of the Kaffir words, I realized that my human horse was chanting an *isibonga* extolling the prowess of his ancestors in bygone days when bloodthirsty Zulu impis rattled the assegai against oval oxhide shields to terrorize this land.

From time to time in sheer exuberance my meandering minstrel would vault high into the air between the traces in a maneuver that forced me to grab hastily for the sides as tail gate scraped asphalt. His massive shoulder muscles rippled smoothly under his exertions, and he carried himself as if supremely conscious of his physical fitness. The white man might have succeeded in breaking him to harness, but nothing could destroy the natural arrogance of a race whose warriors were famed as the fiercest in all Africa.

As we reached the Parade he leveled off to a steady jog trot without acrobatics, and I was finally able to peruse a copy of the *Natal Sunday Post* that I had purchased on the Durban pier. There wasn't much news until I turned to page 24—and that's where my troubles began.

Photos of egrets occupied the entire page, interspersed with shots of black-headed herons. Being incurably interested in natural history, I went on point like a bird dog. Reading carefully, I learned that the rookery was on the Umgeni River "about twenty-five miles from Durban."

This was the buff-backed egret, the ubiquitous bird that consorts

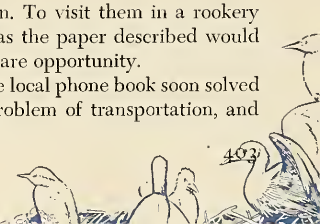


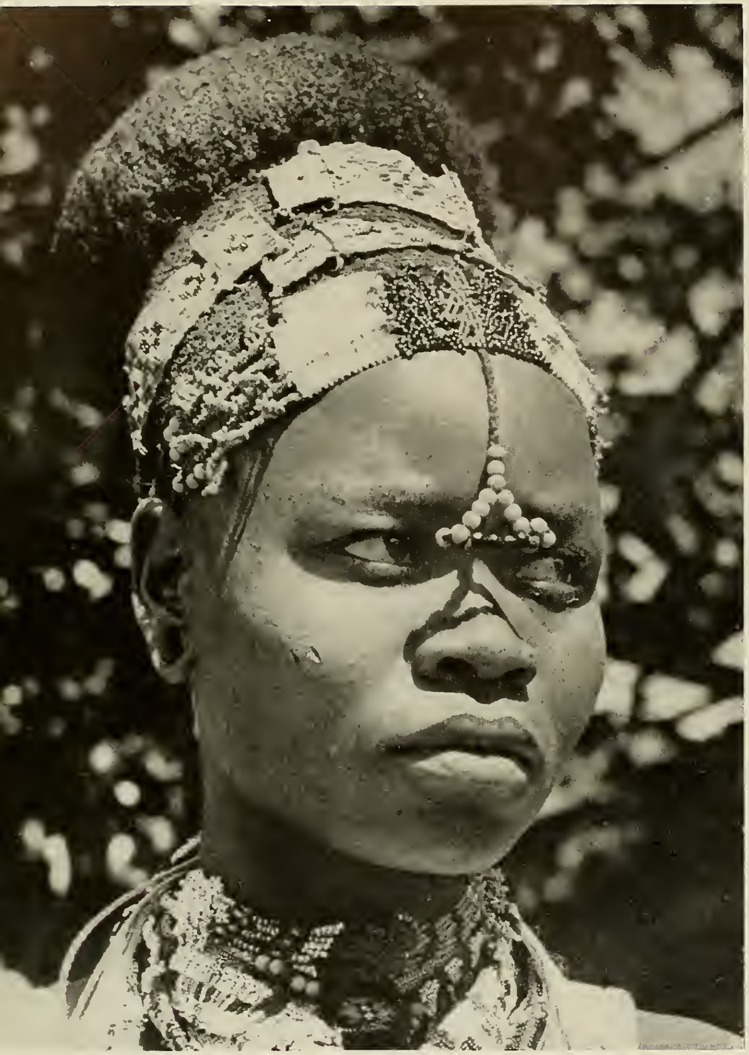
with cattle, buffaloes, and elephants in order to snatch grasshoppers stirred up by the grazing animals, and hitchhikes on their backs to save exertion. The species is found throughout Africa, and in Egypt unscrupulous dragomen point it out to gullible tourists as "the sacred white ibis."

▲ THE RICKSHAW BOY's headdress was composed of beadwork, cow's horns, a carved wooden bird, and discarded light bulbs embellished with turkey feathers. Note the banded porcupine quills at the very top

On previous expeditions I had often seen these egrets in the marshes or flying homeward in the evening in large flocks, their measured wingbeats being poetry in motion. To visit them in a rookery such as the paper described would be a rare opportunity.

The local phone book soon solved the problem of transportation, and





▲ THE ZULU GIRL who had the bearing of a princess and was as nervous as a trapped leopard

with an address scribbled on a scrap, I rickshawed to the office of a chartered cab company. A tiny woman with silver hair at the desk said that she wasn't exactly sure where the bird sanctuary was located but she would call the gazette and find out. Leaving a deposit on my hired vehicle, I left instructions for a driver to pick me up dockside at seven the next morning.

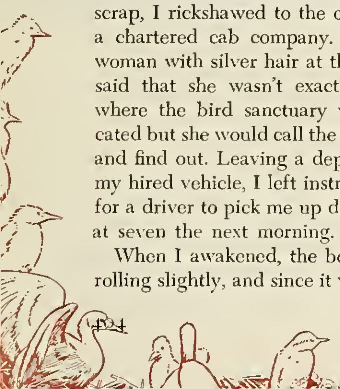
When I awakened, the boat was rolling slightly, and since it was too early for scheduled breakfast, I settled for a bit of stale toast and a cup of the strong black coffee always on tap in the big urn in the galley. Since the weather had been sultry, I wore lightweight khakis and a sun helmet, and when I walked down the gangplank and over the scattered freight piles I found the taxi waiting.

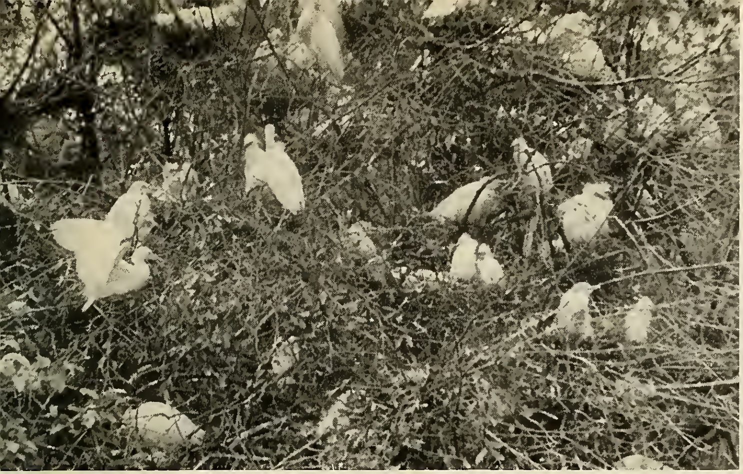
Its chauffeur proved to be the little gray-haired lady of the day before! The agency was shorthanded, she explained, and the war had been responsible for women learning many trades.

We rolled out past the Berea sandstone and into the lush green hills, past blue gums and wattle and banana plantations, and it wasn't until an hour later that I realized my driver was quite vague about our destination. We were a good 60 miles back in the hills and slightly lost when a friendly engineer told us that the birds were some 40 miles away in a different direction. He also recommended abandoning our quest, since it would entail motoring on a one-way mountain road under construction. He added a warning that the engineers would be expecting no traffic and might well crash head-on into us on a curve. His advice merely served as a stimulant to the little woman, who was evidently determined to find the birds if only to prove that she could finish what she started out to do.

Ignoring a large sign prohibiting travel on the Zulu Reservation, she plunged onto the forbidden land and soon was lost once more when the dirt road forked, unmarked. From the slope of the mountain above us came the sound of native voices blended in remarkable harmony, so we climbed toward a thatched native schoolhouse where it originated. A native in horn-rim-

▼ THE QUEST for the egrets led past peaceful Zulu kraals nestled against the slopes





◄ WITH 50 to 60 nests in every tree, the egrets were living like tenement dwellers. Yet beyond their half acre of slums, the euphorbias were bare of birds

▼ A DISTANT RELATIVE, the Crowned Crane, eyes the untidy rookery of the egrets, seemingly with disgust

med glasses approached and proved to be the headmaster, a courteous chap who spoke flawless English and helped orient us. As we started back to the car, the childish treble of 50 small Zulu children rose in crescendo in magnificent music.

We found the engineer's road finally, but it cost us another hour of wandering past neat Zulu kraals, past bronzed women hoeing mealies, and fat cattle browsing. I was responsible for a short halt when I asked my pint-sized driver to stop while I stalked a Zulu maiden who was shy as any antelope on the veldt. Crouching in the high grass in ambush, I snapped her picture as she passed a great clump of devil's-daggers. At the click she bolted into the bush like a duikerbok. I called after her, *"Vela sikubone wena"* (Come forth that we may see you), but it took the woman's wiles of my driver plus the clinking of a few shillings to persuade her to emerge. With high-swept coiffure she had the bearing of a princess, accented by a headband of beadwork. Between her eyes dangled a triangle of big red and white beads, and all during the session before the camera she was nervous as a trapped leopard.

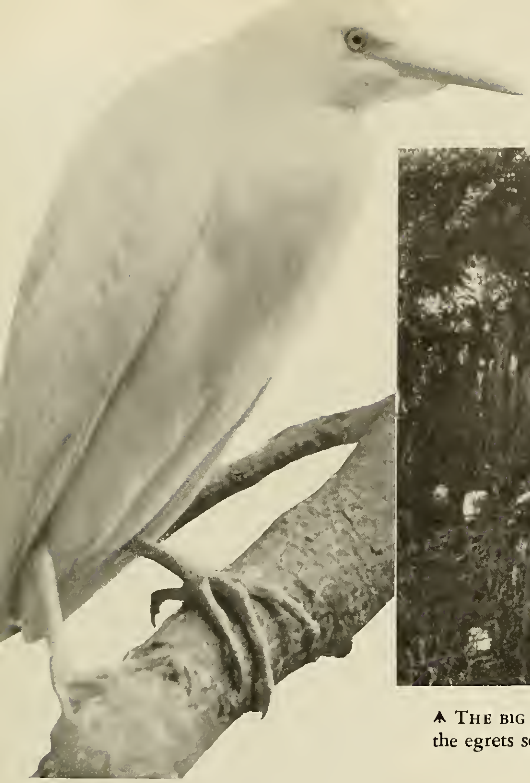
We were soon far into Zulu country, and above us purple clouds were gathering in ominous fashion. I didn't fancy their looks, but these, like the "posted" sign, were ignored by my intrepid female guide.

Just about the time we were ready to turn back, discouraged, we stumbled upon the birds, and it was a fantastic sight. The patch of euphorbia they had picked was scarcely half an acre in extent, and they dotted the cactus-like trees as if they were Christmas tree ornaments. The surrounding euphorbias were bare of birds, yet the rookery was overflowing until branches were breaking under the weight of the close-packed nests. Like tenement dwellers they had built 50 to 60 nests in every tree until it hardly seemed there could be breathing space for all the occupants. The nests themselves were haphazard affairs made of short lengths of reed or twigs placed crosswise. In one where the mother bird was absent, I saw a clutch of four pale blue eggs.

As I got out my photographic paraphernalia, a few big raindrops splashed across the windshield of the car, and I knew I wouldn't have much time. The black clouds that bunched over us promised dire things and were no help whatever for picture-taking.

As I approached the rookery the din was deafening, and it increased in volume each time I neared a nest-laden tree. The birds themselves showed little fear and none of the wariness characteristic of them when met in the bush. Consequently, I was able to see many at extremely close range. This was the buff-backed egret (*Bubulcus ibis*), which is stockier than most other herons and has a yellow bill and orange-yellow legs. The eyes and lores are pink, and during the breeding season the plumage of the head, crown, back, and breast is a rufous-buff, with the rest of the bird snowy-white except for a creamy edge on the wing coverts. Its untidy housekeeping and raucous voice coupled with the rain made serious photography difficult in the extreme.

A bedlam of boisterous birds surrounded me. Fathers were screeching to their mates, mothers clucking to their young, youngsters battling each other, and fledglings, ousted from the nests, were squalling piteously on the ground. Even as I watched one particular nest, a fledgling wobbled to the edge in a greedy effort to intercept his food-laden mother as she alighted. The rush of his brothers shoved him right off the edge to plummet 30 feet downward, where he bounced off the moss like a rubber ball. It didn't seem to injure him, and since it was impossible to climb the euphorbia, I simply placed him in a lower nest. The two



◄ The Buff-backed Egret is stockier than most other herons. It has a yellow bill and orange-yellow legs. The eye is pink

▲ The big Black-headed Herons were top dog in the rookery. They kept the egrets segregated in the lower floors of the apartment

occupants squawked and stabbed at the intruder, but even so, I decided he was safer there, unwelcome as he was, than at the mercy of hungry mongoose or genet on the ground. Above him his brothers were oblivious to his problems as they fought for a chance to delve deep into their mother's beak after food.

In another nest a brooding matron was minding her own business when a neighbor walked on her head. As soon as the foot was removed, she coiled her head like a cobra and stabbed him in the posterior with a needle-sharp beak. Her unmannerly visitor departed in haste. A group of egrets in the higher branches were playing a sort of "King of the Mountain" game, flying at a comrade on a perch to confiscate his place, only to be challenged and dispossessed themselves a moment later. Older birds were huddled like statues on the tips of the euphorbia arms, glum and solemn. A single bird to my left was ignoring all the rest; framed between two spiny arms in handsome fashion, he was disguised as a Japanese print.

The chattering white birds were held in a sort of semisegregation by the big herons. These bold black-crowned buccaneers were top dog in the roost, their roomy nests occupying the tip-top branches of the tallest euphorbias. Occasionally one or two egrets would alight furtively at the edge of the heron nests as if paying their respects, but I noticed they kept out of range of the snake-like head of the bigger bird.

The rain was pelting down now, and my driver was making frantic motions to me to finish my work. The red dirt road was slippery as I hauled my equipment back to the car, and it was only when we headed back up the mountain grade that we discovered the rain had been coming down heavily behind us all the time we had been at the Umgeni. It had reduced the road to muck. To make it worse the narrow highway was flanked by sheer drop-offs running into thousands of feet. Lacking chains, we slithered out of control toward them far too often. Several times I found myself looking past the door handle at jagged rocks far below and wishing fervently for a parachute, particularly when one vicious skid took our rear wheel half over the rim of the precipice. Around the next bend the road slanted the opposite way, and this time the skid catapulted us into the bank and into adhesive gumbo up to our hubs. No amount of coaxing would extract the vehicle from the trap, and the spinning wheels only dug deeper.

The rain by now was a torrential downpour such as only monsoons can produce, and when I stepped out to push I was soaked to the skin within ten seconds.

We were bogged down in the mountains on forbidden Zulu territory, and it was highly unlikely that anybody would come looking for us in that remote spot. My wristwatch said five o'clock, and neither of us had eaten since early morning, my breakfast having been barely enough to keep a canary alive. We had brought no lunch, since we had hoped to make the trip in a few hours, and we had more water than we cared for. Adding insult to injury, the car had been hired by the hour, and already the cost had mounted alarmingly.

Remembering a Zulu kraal a mile back down the road, I decided to hike there to enlist some natives as pushers—an excellent scheme which failed, owing to the absence of all males. The only inhabitants, two fat Zulu matrons, accompanied me back to the car. The downpour had reduced my sun helmet to a limp toadstool affair with undulating brim, and my last few cigarettes were floating around in my pants pockets.

The Zulu women offered to help push, and we tried it. It must have made a ludicrous scene, now that I survey it in retrospect, with the wispy gray-haired lady at the wheel and me up to my knees in muck, flanked by two tribeswomen who were stark naked except for a leathern moocha, a sort of small apron, and the usual strings of beads. It was a picturesque if unsuccessful attempt at liberation.

Several other natives had arrived now to watch our little act, and one of them was an intelligent-looking youth. "Hey, John!" I yelled at him through the downpour—all Zulu men being called John by the settlers, just as all Zulu women answer to "Mary." He shuffled over. "*Inkabi?*" (Oxen?) I queried hopefully, and when he nodded his head shyly in affirmation and said that he had some at his kraal, I sent him off posthaste. When he returned an hour later, my hopes were somewhat dashed because the "oxen" proved to be heifers, scrawny ones at that.

The lad seemed so proud of his pathetic beasts that I decided to humor him. I pointed to the bogged-down car.

"*Bopelanini izinkabi zetu!*" (Hitch our oxen at once!) I ordered, and he hastened to comply, coupling them to the bumper with barbed wire and a length of rusty logging chain. Conscious of his admiring local audience, he made a big production out of it.

With the heifers ahead, grandma at the wheel, and my assorted naked comrades flanking me behind, we were ready to try again. The motor roared, the Zulus grunted, the boy yelled at his teams, but all that resulted was a wave of muck thrown over us by the spinning wheels. Then we tried it without the engine, and slowly, surely, the patient beasts, augmented by our man and womanpower, pulled the stricken vehicle from the bed of mud that had entrapped it.

It was a happy moment, except that I remembered other grades and other traps that lay ahead. We weren't out of the woods yet, and I was frankly frightened at the thought of the precipices yet in our path. With a modest amount of haggling, I quietly coerced the boy into convoying us with his yoked teams for the few remaining miles of treacherous road. Using the engine only to assist the animals on the steeper grades, we finally emerged onto the wider surfaced highway.

With a hasty good-by to our young rescuer, we scooted over the good road, completely forgetful of the fact that to get off the Reservation we would have to climb one more unsurfaced hill. We tried to make it ten times, our wheels spinning without traction, only to slide inexorably back down. We surrendered, finally, to huddle hopelessly in the car, wet and hungry and facing the prospect of combatting the chill mountain air. The rain was still descending in torrents.

There was no glimmer of light to be seen anywhere through the wall of water, and there was nothing left to do but make the best of a bad deal. Grandma, shivering in her thin cotton dress, curled up on the front seat, while I jackknifed my long legs onto the rear cushions after removing my muck-covered boots.

All night long, when I wasn't wondering whether my ship had sailed without me, I kept thinking about T-bone steaks I had known, thick juicy ones, until I was ready to eat the upholstery. I was afraid to doze for fear of waking with pneumonia, and the clammy clothes helped keep me awake.

With the advent of daylight, Zulus began trekking past toward Botha Hill, and we sent out messages by them. It was almost noon before we got an answer from civilization in the form of a tow truck, and to complicate matters it almost slid down the hill on top of us. It took the brawn of a dozen husky natives to get us and the truck back up the slippery slope to the main highway. When we stopped at an inn for sandwiches and coffee, we wolfed the food as if we'd been marooned a month.

My boat fortunately was still in the harbor, the skipper having insisted that the police hunt for my corpse all over town. Eventually I left the delights of Durban, but I knew I wouldn't forget Natal in a hurry. It was there that I'd met the egret—to my *re*gret—and I vowed in the future to leave bird-watching to seasoned ornithologists. I'd stick to rhinos; they're easier on the nerves.

▼ THE BEGINNING of a bad night. The Zulu boy and his "oxen" convoyed the car to what seemed to be a safe place. But one more stretch of mud halted the expedition until the following noon

A Fair Day's Pay

Adventures in the swift waters of the Surumu and in the financial philosophy of a band of copper-colored rivermen

By GEOFFREY M. TATE

Staff Member, Archbold Expeditions, American Museum of Natural History

Lee Garnet Day Expedition Photographs

BY sheer contrast, I was reminded recently of my first experience in paying natives by means of trade goods. I had gone over to see my friend, Henry, the purser of the good ship "Pioneer Star," which brought members of the 1948 Archbold Cape York Expedition back from Australia. He was paying off the crew when I called, and I watched the money change hands as the men filed in front of his window. Everything moved and clicked like well-oiled machinery, but my thoughts skipped back through the years to the sound of native drums in a forest clearing and to a very different payoff with a fantastically incongruous currency.

Don Carter, my brother George, and I were working our way north from the Amazon River toward Roraima, that phantom mountain of many legends. We were not the first to climb the sheer cliffs protecting the flat summit of Roraima, where the ghosts of the dead Macusi and Jarecuna warriors find their happy hunting grounds, but we were the first to explore fully its cold, mist-swathed top. My little story deals with the part of our pilgrimage between a settlement called Frechal and the native village of Maloka Limaõ, in the territory of the Macusi. Frechal lies on a tributary of the Amazon called the Surumu. The rapids of this river ran with such fury that we simply were not strong enough to get through with our two canoes—a heavy one that we had brought clear up from Manaos and a light one we had purchased from the Frechal rancheiro. So George had gone ahead to Limaõ in order to send back additional Indians to help us.

It was late afternoon when the Indians reached our camp among the trees along the river. They were copper-colored, muscular, squat little men—robbers, murderers, cannibals, and worse, said the rancheiro as he hustled his family into the stockaded shelter of his home. Indeed, we knew that the reputation of the Macusi was not founded on gentleness. They looked everything that the rancheiro said they were. A few wore flapping rags of pyjama-like suits, but most were naked save for a breechcloth of dirty red cotton. They carried knives in their girdles, and each man was armed either with bow and arrows or with the *sabutana*, the blowgun. Some wore on strings around their necks the bulldog jaws of *pirai* – the deadly little fish of the rivers, which hunt in shoals and can strip the flesh off anything that swims. A few had their lower lips pierced and wore nails or sharpened bits of metal in the opening. A stripe of red paint across the bridge of the nose, from cheekbone to cheekbone, added a further touch of ferocity to countenances needing no such embellishment. Tough guys they were said to be, and tough guys they looked.

Their leader handed us a note from George. Our qualms were in no way allayed when we read it. After a short description of the river, it stated that there was much cashiri and paiwari being consumed in Limaõ and that the *tushagwa*, or chief, was drunk on it most of the time. In George's estimation, the sooner we were together again and could offer a solid front, the better. We started the next morning.

We knew from George's letter that we had four sets of rapids to traverse: the Casa Verde, the Maruai, the Providencia, and the Pedra Grande – each more difficult than the one before. However, Don and I hoped to make the trip in five days. It would have been advantageous to portage our food and equipment at the long rapids (both the Providencia and the Pedra Grande ran for over a mile), but this was partially prevented by the size and weight of the canoe we had brought from Manaos. George had purchased her, and his poetic fancy had inspired him to name her "The Pig and Wallow," slightly reminiscent, perhaps, of some country pub in England. She looked every bit her name–this queen of our little fleet. She was about 25 feet long, incredibly broad, and made of planking nearly 3 inches thick. A thatched roof had been constructed over her stern for six feet, making living quarters. Eight men were needed to paddle her in still water, more in rapids, and a whole platoon would barely have been able to lift her. So it came down to a manhandling job for the boat and a carrying operation for supplies and gear.

We started at daybreak. The Pig's crew of ten Macusi paddlers, four to a side and two at the stern, made her travel through the water at a very fair speed. Taking alternate strong and short strokes, they would tap the shafts of the heavy homemade paddles against the gunwhales of the canoe, producing a sort of rhythm that they could keep up for hours. The smaller boat had no difficulty in keeping up with The Pig, and there were no mishaps on that first day, though our thoughts were constantly with George and the alcoholic *tushagwa*.

We reached the Casa Verde rapid early the next morning. Here the river was split by a large sandstone island, and the water, compressed on each side of it, ran like a millrace. We unloaded all our movables and carried them the quarter mile up to still water. Then we returned to face the problem of The Pig and the small canoe. We had to depend upon paddle, pole, towrope, and sheer muscular force. The Macusi were like so many fish in the water,

▼ CLOSE TEAMWORK and great physical exertion were necessary to work the unwieldy "Pig" up the Surumu through its four rapids. The jungle men who did the work did not know the meaning of monetary reward

Photo by T. Donald Carter

To LIGHTEN the boats, the baggage was usually portaged up one side of the river or the other. A slip might mean a plunge into deep water and a leg torn on a jagged rock

Photos by T. Donald Carter

encouraging each other with shrill yells and shouts of *"Cai en agua"* (roughly, "get in the water and work, you so-and-so"). When one of their number would slip on the shelving, slimy rocks and skin his leg from knee to ankle, they would laugh with sadistic glee. We were all pretty well used up when we reached the head of Casa Verde rapid, but before slinging our hammocks and making camp we loaded the canoes again, ready for an early start the next morning.

For a few miles, the traveling was uneventful, though of course the farther up we went, the more powerful and difficult the obstacles became. We were determined to lose as little time as possible, not knowing how things might be with George. The second rapid, the Maruai, was a tough one and gave us warning of what we might expect at Providencia and Pedra Grande. Cliffs formed the banks of the river at Maruai, and the job of getting all our stuff up the steep bluffs to the trail was an exhausting one, not to mention carrying it for a full half mile. Then came the matter of getting The Pig and her consort up the rushing stream.

In spite of their great aquatic ability, the Macusi were constantly swept off their feet by the force of the current. When that happened, they had to cling to the sides of the boat to save themselves from being swept away. Meanwhile, those of us who remained upright, braced ourselves against the double burden of boat and men and strained every muscle and tendon to prevent the whole works from being washed down to the foot of the rapids. We finally conquered the Maruai, but one rapid like that was enough for one day. When we made camp, the Indians were as tired as Donald and I. Only Sunny, our little mascot dog, who seemed to enjoy being battered around by the torrent, had much spirit left.

The muscular, compact bodies of the Macusi seemed to glow in the light of the fire as they sat in a circle around a community stewpot, dipping their hands in and tearing and gnawing the tough beef. Tough, sullen men they certainly were, squatting on their heels in simian posture, but where could you find better rivermen?

The stars were still shining brightly when we started out the next morning, and the waning moon bathed the river and its banks in a pallid blue radiance. In the cool morning air, we felt optimistic, but when we entered the Providencia, we realized that only good luck would enable us to complete the journey in the two days that remained in our schedule.

This rapid was about a mile long, and we started our battle against it in the early afternoon. By nightfall we had worked our way up about three-quarters of its length, and we knew that we could not fight the river in the dark. So we made our boats fast fore and aft to trees on the bank, in an eddy away from the full pressure of the stream. Then we

➤ MOST of the Macusi were naked except for a red breechcloth. They carried their hunting weapons with them and were a tough-looking group of men

Photo by G. H. H. Tate

cleared a small space in the underbrush and made camp there.

Heavy black clouds to the north heralded a deluge, which we knew would flood the river. A couple of days before, a cloudburst in the same direction had raised the stream four feet in one night. We felt that, while we could escape the Providencia as soon as we had light enough, the Pedra Grande, which was the worst of the four, would give us such a battle that the others would seem like child's play. George, marooned up there at Limaõ, had reported that it had taken his party nine hours to overcome it, and they had been lightly loaded. Don and I felt more than a little awed.

Rested and fresh from a night's sleep, we passed the remainder of the Providencia and reached the foot of the Pedra Grande in fairly good time. Here the river, a couple of hundred yards in width, foamed and thundered between two massive granite tors, each about a hundred feet high. We had met our Scylla and our Charybdis, and we hoped that the luck of Ulysses would be with us.

We followed the usual procedure of landing and unloading, and portaged our stores to less exciting and excited waters above the rapid. There we tethered Sunny, too, not daring to let him pit his stout heart but light weight against the whirlpools and cascades of the Surumu. Then we walked back and started the worst tussle of the lot.

The depth of the water in the Pedra Grande varied. In some places there was a bare twelve inches where the stream flowed over a shelf of rock, but the next step might take you into a pool five or six feet deep. Fortunately, there were trees scattered along the riverbank, to which ropes could be fastened. Sometimes we would expend the most stupendous effort for fifteen minutes to make secure a gain of only a few feet. Rocks jutting from the foaming water could be used to advantage as snubbing posts, but they also became deadly menaces against which the boat might crash when she slipped from our hands. There was one great thing in our favor – there was no danger from *pirai* or alligators in water as bad as that.

"Cai en agua," yelled the Indians to each other, and *"Hi capybara"* (referring to an animal famous for its swimming ability), when one of them slipped and was washed along one of the jagged stone shelves or disappeared beneath the surface to emerge 10 or 20 feet downstream.

Disaster loomed ominously close when at one point all the men supporting one side of The Pig were swept off their feet. The boat was snatched from the grip of the men on the other side and from those who were towing, and was smashed with sickening force against a sharp-edged rock. Fortunately, none of the men were hurt (no one was caught between rock and boat), and she stuck there long enough for all hands to get back on the job and bring her under control. But the poor old Pig's three-inch timbers were cracked, and a part of her heavy keel was sheered clean off. It became a personal fight; everybody cursed the current. Muscles bulged; tendons and sinews cracked. The stout poles frayed and split at the ends. A hot sun beat down, scorching the parts of our bodies that were not under water. In the distance, Sunny's excited barking lent further encouragement to us. Gradually the powerful stream lessened; the undertow swept less violently at one's feet and legs; the sharp rocks became less frequent. And then the job was done, and the mile of wild white water was passed – in six hours.

From the head of the Pedra Grande to Maloka Limaõ was only a half hour of easy paddling. We found George hale and hearty, and over his shoulder Guaracaibo and our private Peruvian Indians were grinning a welcome. Behind them was the whole population of the village, augmented by a hundred or so other Indians who had come long distances for jobs as porters. One sturdy savage, whose garb consisted almost solely of a woolen skullcap, poked a knotty thumb into his chest and said *"Inglis, Inglis,"* meaning that he had come all the way down from British Guiana. But before we could sign on porters for the overland job, we had to pay off the rivermen for getting us to Limaõ.

George had told the Chief that they would be paid on the day after our arrival. That evening, after I had issued some dried fruit to our cook and it had been stewed for a celebration supper to commemorate our reunion, the boxes containing the trade goods were opened. We constructed shelves from our collecting and specimen cases on which to spread the galaxy of wondrous things from which the Indians would make their selections. Coinage to these tribes had no value unless it was perforated and could be slung around the neck as decoration. Paper money could not even be used in that way. What was in demand was something either to comfort the inner or adorn the outer man.

Knowing this, we had laid in at Manaos a large supply of coarse cotton cloth, fishhooks and line, needles and thread, machetes, axes, nails, and such things. These were the staples, the necessities, together with salt, dried beef, and *farinha*, a gritty sort of corn meal. But we also had our luxury counters. Before leaving New York we had spent many hours and dollars browsing in Woolworth's and like places and had purchased a goodly supply of inexpensive face powder and perfume, lipsticks, combs, rubber dolls that squeaked when pinched, harmonicas, mirrors, jewelry, and a host of other things. The quantity both in luxuries and necessities was large.

All night long, across the point on which our camp was situated, we heard the beating of drums, shrill yells, and the slap-slap of dancing, naked feet. The yelling grew louder as more and more cashiri was consumed, and long before dawn we heard the feet closer to our tent and the rustling of the grass and scrub as the Macusi drew nearer to the pay office.

We breakfasted at the crack of dawn, with scores of gloomy and fantastic-looking Indians watching every mouthful and clutching bow and arrow or blowgun. We gave the *tushagwa* his personal present, a single-barreled shotgun and a handful of shells, thereby winning his approval and favor. Then Don and I drew away the cloth that concealed the array of goods, while George, with a grand gesture of his arm like a ringmaster, directed their eyes toward the shelves. We could almost hear the surge of emotion.

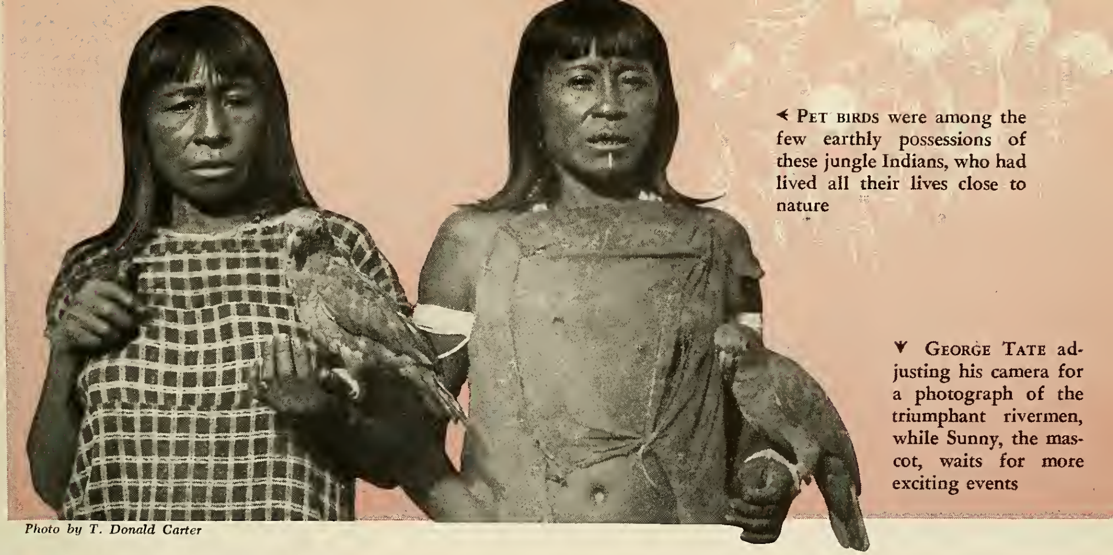
One point was greatly in our favor. If some especially beautiful and unusual object from America del Norte became too popular and consequently began to run short, we could set an arbitrary value. Too much or too obvious manipulation might get us an arrow in our ribs; the *tushagwa* was supposed to see that his people got a square deal, but the severity of his demands depended upon the size of his personal bonus. Indeed, he acted almost like a "civilized" person!

Although cash and currency were unknown and unwanted by the Indians, five milreis worth of trade goods per day was the established rate of payment for rivermen and porters. Other unskilled labor received less. The milrei then was valued at about 13¢, but the things we were offering as payment had incredible worth for the Macusi. The rule of supply and demand was taking its rightful place in the scheme of things.

How those things gleamed and glimmered in the early morning sunlight – rubies and emeralds in the Woolworth rings, sparkling diamonds in the necklaces, pearls in the combs, and gold in the ten-cent mirrors and compacts—things they had never imagined before! They were going to be well paid, by their standards; by ours, they had done excellent work very cheaply. There were between 30 and 40 men, each with a pay check of about 35 milreis. Each of them had about five other men, women, and children watching avidly and yelling suggestions. Nothing was done quietly.

The first things they selected were red cloth for their breechcloths, some salt, and enough of the heavy cloth to make a frock for a woman and pair of trousers or a hammock. Needles and thread to sew the material together and perhaps a machete and some fishhooks and line usually completed the list of necessities. Then the warrior and his woman shopped around among the luxuries, not even understanding the use of some of them. Mirrors and harmonicas took hold at once. The Indians got immense pleasure from making hideous faces at themselves in the one and producing awful noises on the other. So great was the demand for plain mirrors that we had to increase the value of the compacts. They had cost the same as the mirrors, but the operation was not questioned, because the compacts had two sides and were obviously worth about twice as much!

Hotter and hotter we grew as the sun climbed higher, and stronger and stronger grew the smell, altered occasionally when a bottle of virulent perfume was opened and a few



◄ PET BIRDS were among the few earthly possessions of these jungle Indians, who had lived all their lives close to nature

Photo by T. Donald Carter

▼ GEORGE TATE adjusting his camera for a photograph of the triumphant rivermen, while Sunny, the mascot, waits for more exciting events

Photo by T. Donald Carter

drops were spilled or applied to some copper-colored visage. Don and George acted as salesmen, pointing out the desirability of articles that were not moving well. I spent most of my time keeping Sunny and the village dogs apart. Our negotiations were conducted in the *lingua geral*, a mixture of Portuguese and Indian dialect, at the top of our respective voices so that we could hear each other above the yelping of dogs and Indians.

The lipsticks, the retractable type, were not understood at first and did not move. So George borrowed one of the women and posed her while Don did up her face. That started them going, and when one of the warriors hit on the idea of using one to freshen up his own war paint, gazing enraptured at himself in the mirror while he put a bright stripe across his nose and cheeks, a regular run on them started, and the women never had another chance. Up went the price, manipulated by us financiers, and the demand was transferred to some other article. Don, who can mimic birds and animals so naturally that they will themselves come to him, would squeeze a rubber doll and imitate the sound in such quick succession that even he became confused. This split the usually morose Indian faces into an almost amiable grin, which would have been a hearty belly-laugh in anybody else.

By the time all the Indians had been paid, and they and their brothers, fathers and mothers, sisters, cousins, and aunts had returned chattering to the village, we were exhausted and almost deafened by the babel of hoots, gurgles, grunts, screams, and quarrels that had been going on in our "bargain basement." The Brazilians and our two Peruvian Indians had prudently kept out of sight. Sunny had had about seven free-for-alls and felt that enough was enough for one day.

Later, when we came to know the Macusi and other tribes better and realized that those things, so trivial to us, were sheer golden treasure to them, we began to think it over. Certainly we had not cheated them in any way. We, too, had splashed around in the Surumu, torn off fingernails and hunks of flesh against the rough sides of The Pig, disappeared under the water, and wondered where, if ever, we would come up again. We, too, had been paid, differently, of course, but not one bit more richly. Supply and demand had taken hold, and everybody was happy.

Born Alive

By N. J. Berrill

McGill University

Ewing Galloway ph

In our world of living creatures the greatest phenomenon of all is life itself, and with every creature the aim is the same—to perpetuate its kind. Here the author discusses the course that many animals have followed to ensure this

TO be born alive, living from the living, to wake in the world with warm blood already coursing, with a hunger for milk and maternal care awaiting—this is the heart of our mammalian creation. Our company includes the elephant and the mouse and all that can boast of hair, however sparse. And all must carry the navel mark of origin from the cradle to the grave.

The dangers, the pain, and the discomforts of birth and suckling sometimes overshadow the marvelous story of how this process developed. Our ancestors gained it arduously during a million centuries. It was not always this way. Before the time of flowers and seasons, our scaled and cold-blooded ancestors laid large shell-covered eggs and hid them in the earth. In some past infinitely more remote, almost invisible eggs were scattered in astronomical numbers in the sea.

All evolving life has had a choice: to disperse a multitude or care for a few. The aim is the same: to ensure that two or three shall survive to maturity to perpetuate the race. All reproduction has this essential end—the continuity of life in a world of transient organisms. It is our own good fortune that the complexity of our nature and the time of our duration allow enjoyment of mind and senses beyond the demands of propagation alone.

A large egg gives rise to a large embryo, and one which, when hatched or born, closely resembles its parent. Both the size and the habits of the young enhance its chances of survival. The larger an egg, the more likely it will grow up into a breeding adult; but in any case the hazards are great and catastrophe the common fate. The greater the number of eggs produced, the greater the chances that a few will reach maturity. Here lies the quandary, because the production of very large numbers of large eggs is far beyond the capacity of any living organism. Only a certain proportion of growth and tissue can be set aside for the formation of reproductive cells, and some evolutionary decision must be reached —whether to divide this portion into an almost infinite number of minute eggs or into a small number of relatively large eggs, or even one or two enormous ones. One method is not necessarily better than another. It depends upon many things. Of two flat-footed mollusks, the sea hare spawns a half-billion eggs a season, the whelk no more than a few hundred, but the outcome is the same—a population struggling for sheer existence. It is the nature of things to be different, and be-

◀ ANIMALS THAT GRAZE can usually protect themselves from the meat eaters best by running. Young that can run soon after birth stand a better chance of keeping up with the herd when in danger

▶ BEAR CUBS are born under conditions of unusual safety. The female is in her den for the winter and may not even wake up when her young are born

▼ A HAMSTER photographed in its burrow with three youngsters: a scene typical among rodents. Rodents usually depend upon the seclusion of their den or nest to protect their blind and helpless young

Ewing Galloway photo

Fisher photo

tween the Many and the Large lies an infinitude of compromises—scope for novelty in an adventurous universe.

Evolution is essentially a progress from one discovery to another. What is evolved for one purpose becomes useful for another, and this has been the history of living births. Marine serpulid worms possess a calcareous tube that is primarily a protection for the adult worm, enabling it to survive in otherwise dangerously exposed places. Larger species, like those of *Serpula* and *Hydroides,* take no other advantage of this tube; but the small *Spirorbis,* common on rockweed the world over, uses the tube to protect the developing young until they can crawl out as miniature replicas of the parent. Apparently small species, producing fewer eggs, have greater need to take some care of them. The large species of the slipper limpet attach their egg cases to the rock surface. Dwarf species retain them within their mantle cavity.

One thing leads to another. Egg cases protect eggs and are the first step from the abandoned millions to the coddled few. Egg cases also keep out spermatozoa, so that fertilization of the eggs is not usually possible after the cases have been formed. Fertilization within the body of the parent, generally involving some form of copulation, therefore becomes characteristic, setting the stage for living births.

It has happened again and again. Among the cartilaginous fishes, many of the sharks and some skates produce a small number of large yolky eggs, about the size of a pigeon's egg. They are fertilized within the oviduct of the mother before the case or purse is formed around them. They are attached to weed or rock by horny filaments, and after a few months the purse splits open and a small shark emerges. In the nursehound, however, and in many larger sharks, the eggs are not laid. They enter the oviducts and are fertilized there in the usual manner, but the purses secreted around them are comparatively thin and delicate. Development proceeds, and after a time the horny envelope dissolves or is thrown off and the egg and embryo lie naked in the maternal tubes, to be born alive, maybe after a few months, maybe not until nearly two years have passed. Food for growth comes from the yolk of the egg and later from a yolk-sac placenta. In some rays, nourishment comes from hairlike projections on the wall of the uterus. These are drawn into the spiracles, or breathing vents, of the embryonic ray and provide the inborn fish with a milky fluid.

One further step is possible, and this has been taken by certain nurse sharks. As the embryo develops and the yolk diminishes, flat platelike structures develop, richly supplied with blood vessels. These convey not only maternal oxygen to the embryo but all the raw materials for growth as well. A placental organ is formed, which functions like the true placenta of mammals. Thus the developing young are not merely protected by retention with-

Ewing Galloway photo

➤ During the perilous period of infancy, the kid, like its mother, is a skillful rock climber. Through that talent it frequently evades attack by carnivorous animals

in the mother but are for the most part actually nourished internally, to be launched finally from her body as living, lithe images of herself, with much of their growth already attained.

Living births, however, have not led to dominant careers among primitive aquatic animals as they have among the land forms. They have not produced wider freedoms or greater adaptabilities. If anything, they have restricted the range of the animal and led to greater specializations. Those creatures of the sea that are truly emancipated by being born alive, creatures that in speed and range take the oceans for their own, are the dolphins, porpoises, and whales—mammals with an epic of creation and transformation behind them.

Mammalian history is essentially a story of the land. The fishes that successfully breathed the air of the coal forest and eventually came to walk the land as reptiles had a twofold plasticity. In the course of untold generations, not only did lungs take the place of gills, and fins transform to legs, but eggs grew large and yolky, with calcareous shells enabling them to be laid on the land. With shells to be formed, fertilization had to come first. Internal fertilization and the initiation of development in the upper reaches of the oviduct became mandatory. This is the reptilian mode, and apart from the question of heat and warm blood, it is that of the birds as well. The emancipation of the egg from its need to develop in water was an epochal event in the evolution of life.

Bird photo

◄ Walruses up for air: a study in symmetry in a zoo pool. Full-fledged mammals despite their marine life, walruses are born alive, like whales, porpoises, and dolphins. They recognize few enemies among the other creatures of the sea, who scatter millions of eggs in the hope that a few may survive

➤ HUMMINGBIRD EGG and ostrich egg: extremes in a method of reproduction that has long been successful. Increasingly dry climate is thought to have caused the development of drought-resistant shells on eggs that were previously soft, thus enabling them to survive out of water

A.M.N.H. photo

Ewing Galloway photo

▲ THE HEN has become such an "egg-laying machine" that man has taken her under his protection. She lays far more eggs than are needed for survival

The first transformation, from an egg similar to a frog's to one very much like a hen's, was part of a response to environmental changes. The carboniferous forests and swamps were shrinking; the land was growing drier, with increasing exposure to light and air. The later transformation—the retention of the egg within some part of the body, with subsequent loss of the shell and yolk—was equally a response to an environmental challenge.

Early in the evolutionary rise of reptiles, the climate of the earth became colder, and about the same time the first mammal-like forms appeared. When the climate grew warm again and the reptiles reached their culmination, these mammalian progenitors took a low and humble place. They later showed that the meek could inherit the earth, but our only surviving representatives of those early egg-laying mammals are the rather specialized platypus and spiny anteater. These two have never graduated from egg-laying, but they show a solicitude for their eggs more acute than that of reptiles or even birds.

The habits of the spiny anteater are especially illuminating. It does not bury its solitary egg and leave it behind as most reptiles do. Nor does it lay it in a nest that would hold the parent to one locality. It carries the egg in folds of the pubic skin, practically a pouch, imparting to it both protection and a degree of warmth from the maternal body, without sacrifice of daily travel. Not only this, but incubation of the egg actually starts within the uterus of the mother and continues there from two to four weeks. That is, a shelled, yolky egg is retained within the parent for a considerable part of its period of development and is thereafter kept safely within a skin pouch. In a sense, the embryo is born alive, even though the egg itself is unchanged and is still the box-shell that freed the four-legged migrants from water to roam the surface of the earth. Even milk glands are already present in the mother to carry young life a little further on its journey through time. The spiny anteater's only living relative, the platypus, produces very similar eggs but lays them in a nest in an underground burrow. This custom is probably necessary as a consequence of the great amount of time the platypus spends in or under the water, for the eggs would be quickly killed by submersion.

The true pouched mammals, the marsupials, took the next step. If a developing egg remains within the uterus of the mother, a calcareous shell is an unnecessary protection. It is, if anything, an obstacle to "respiration." Thus the shell was eliminated by the marsupials. With its going, maternal nourishment through embryonic membranes became possible. Consequently, only a very minimum of egg yolk is actually necessary, and we find shell-less and virtually yolkless eggs, no more than one-sixth of a millimeter across, developing in the uterus to a stage recognizable as a mammal. When the little creature is born, it is sufficiently advanced to fumble its way to the all-essential milk of the mother.

The opossum of North and Cen-

Acme photo

▲ Kangaroos and other pouched animals are ill-equipped to nourish the young in the mother's womb. Hence they are born in an "under-developed" condition so they can take advantage of her milk supply

tral America is fairly typical of the marsupials. Baby opossums are born after thirteen days in the uterus. Each is about the size of a hornet. Most of the internal organs can be plainly seen through the transparent wall of the body. Yet they have to find their own way, without the help of the mother, through the forest of fur on her abdomen, into the small opening of the pouch.

Often as many as eighteen young are born at a time, with about twelve teats to support them, so that one-third—the slowest, the weakest, or the latest—are doomed from the start. The more fortunate hang on to the teats for dear life and within a week increase their weight tenfold. After two months or so, when about the size of mice, they start taking rides on their mother's back. They leave her for good when they are about three months old.

The reason why the young of these pouched animals have to get to the milk supply is that they have no special arrangement for getting nourishment in the mother's womb. At one time pouched animals overran the earth. But when other mammals developed the vascular membrane known as the placenta, the pouched mammals were swept from the scene, except for those that have taken to the trees in the Americas or found themselves in the sanctuary of water-bound Australasia. The placental mammals took the last step with regard to the close interlocking of embryo and mother. The placenta took the place of the yolk sac of earlier animals and became the organ that controls and transmits all of the necessary exchanges between the blood of the mother and the blood of the embryo. With this new invention, the period of gestation, or nourishment within the womb, could become as long as the subsequent period of suckling. In a general way the two periods are fairly well balanced for most present-day mammals, including man. The combination of uterine nourishment and suckling has placed the true mammals at the top of the pyramid of life, and man, who has made the most of this combination, is inclined to feel that the rest of the pyramid exists to support him.

Small mammals, such as rodents, usually produce litters of up to a dozen blind and helpless young. Large mammals generally produce a single offspring. There are, of course, exceptions; but most large mammals live for a good many years. They are relatively immune from attack by small ones and can readily maintain their population at this rate. Small mammals are often the prey of larger ones, especially before man and his gun upset the balance of nature; therefore, much larger numbers have been necessary for the maintenance of their kind. On the other hand, their quick maturity, incessant breeding, and rapid development can, if unchecked, lead to fantastic situations. A single pair of house rats, if allowed unlimited food, space, and safety, could give rise in only three years to 350 million, for they have large litters of nine or ten, with three to six litters each year, and they start breeding when three or four months old.

This is merely the *potential* reproduction. Natural enemies normally keep numbers in check, and the food supply finally calls a halt if nothing else does. Lemmings can breed as intensively as any rat and are less restrained. Every few years, as the numbers reach their peak, the plants on which they feed disappear under the onslaught of millions of small jaws. Then starvation, lack of space, and fouled runways set off in some manner the famous suicidal migration to the coast and a watery grave.

In all such litters, the offspring are not like identical twins, which come from a single egg. As many eggs are fertilized as there are young, and they are no more alike than brothers and sisters except that they are of the same age. The armadillo, on the other hand, produces a litter from a single egg, the members of which are identical. In the Nine-banded armadillo, the single fertilized egg gives rise to four embryos shortly after the beginning of development, so the birth of identical quadruplets is the rule and not the great exception. In the closely related Mulita armadillo, as many as twelve identical twins develop from a solitary egg.

In each of these instances, a single placenta is formed, to which the individual cords of all the embryos are attached. In ordinary multiple births like those of cats and mice, each embryo forms its own placenta. The same difference distinguishes *identical* human twins from *fraternal* twins.

Being born alive, even from a true placental mammal, can mean one of a number of things. The life that must be followed immediately after birth profoundly influences the nature of the offspring. The large grazing mammals that can escape from their enemies only by running cannot afford to have small, helpless young. The more alert the young are and the more able to run shortly after birth, the better their chances of keeping with the mother and the herd when in danger. Suckling is as necessary as ever, but the one or two offspring born to most of the hoofed mammals are as much like their fleet-footed parents as it is possible for the newly born to be. They are born large and long-legged—as large as the mother can bear. The pigs, however, are not built to develop great speed. Their answer to the problem of survival is more like that of smaller mammals, with the production of rather large litters, out of which some may survive to maturity. Their chances of survival are also increased by the fact that a wild boar or sow will put up a formidable fight to protect the young.

The largest animals of the land—the elephant, the rhinoceros, and the hippopotamus—find security in their size and their thick hides. They have little need to run. Their size and strength are also a protection to their young as long as they can keep together. But they must keep moving to keep eating, and so again we find the offspring extremely far grown at the time of birth. A single embryo develops at one time, taking eighteen months to complete its course in the rhinoceros and twenty-one months in the elephant. The calves can walk at the side of the mother virtually from the time of birth. They are already so big that only the largest carnivores can safely attack them, and the concerted action of a herd may give the calves a great deal of protection.

Ewing Galloway photo

▲ **CAMELS** can subsist farther from water than most of their enemies, but in a pinch the young one can keep up quite well with its long-legged mother

Such giants are exceptional. Most mammals give protection to their young until some time after weaning by keeping them in a safe lair or burrow. Breeding is usually an annual routine, either in spring or fall. While a long, slow process of gestation in the womb has its advantages, the period must not exceed a year if the annual cycle is to be maintained. Otherwise the breeding season is reduced to no more than once in two years. When paternal affections are less than the attraction of a good meal, rather difficult situations may arise. The fisher shows this very well. This fox-sized relative of the weasel is neither a fisher nor a fish-eater but

Continued on page 431

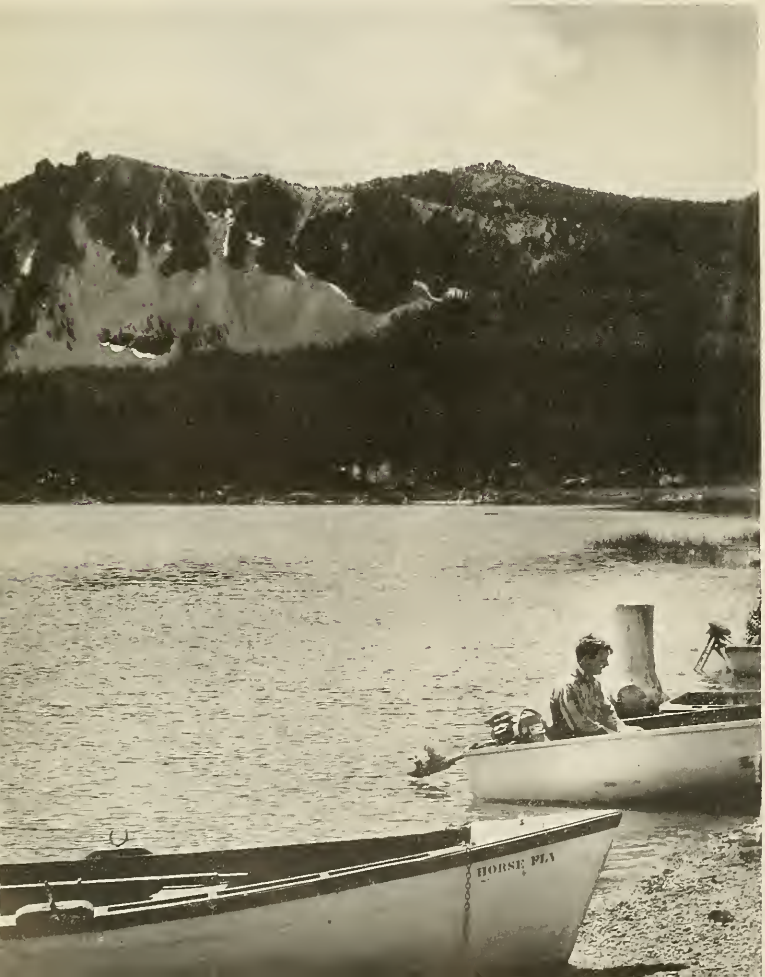
DEATH MASKS in Lava

A forest is preserved by the same hand that destroyed it

By DOLORES BUTTERFIELD JEFFORDS

▼ PAULINA LAKE, in central Oregon, was formed after volcanic activities subsided. A portion of the Newberry crater wall is in the background. If all sections of the crater wall had remained intact, a single lake, up to 2000 feet deep, might have been formed in the crater

Oregon State Highway Commission photos



TREES have been buried alive, carbonized, petrified, and otherwise treated roughly by volcanoes throughout prehistoric ages. But it remained for a comparatively modern volcano in the Cascade Mountains of Oregon to destroy a forest while preserving in lava remarkably perfect death masks, so to speak, of the vanished trees.

Lava Cast Forest, adjacent to the Deschutes Game Refuge in Deschutes National Forest, is a creation of one of the last eruptions of Newberry Crater. This extinct volcano was discovered in 1826 and was later named for Dr. John Strong Newberry, a geologist of note, a physician, and a member of the Williamson Expedition, which explored central Oregon in 1855. Al-

▼ THIS TUNNEL marks the site wher once lay a prehistoric log. When the lo

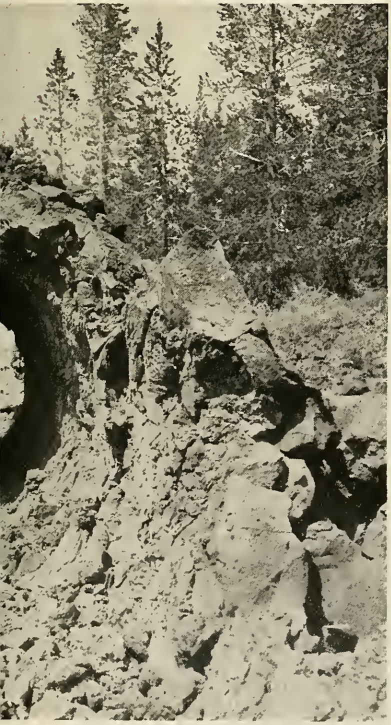
though its greatest activity occurred during the Pleistocene Age, the volcano erupted spasmodically up to within the last few thousand years.

The cone of this great mountain, like that of its famous neighbor to the south, Mount Mazama, collapsed into its own crater. After the collapse, spasmodic eruptions continued, the lava pouring over the rim of the crater and down the slopes.

Below this vast mountain, on its northwestern slope, lies Lava Cast Forest, on a road that runs east from U. S. Highway 97, at the northern edge of the Game Refuge. Though called a forest, it is a treeless waste, a jumble of black basaltic lava, rough and broken, in the midst of which is a little geological museum. Centuries ago the forest that stood there was inundated to a height of some 20 feet by a flood of lava. The charred, dead trees disappeared, but the cooled lava retained their shape, size, and even the imprint of their bark. In an area of several square miles covered by this flow—which is superimposed upon other much older flows—there are a great number of these cylindrical lava casts, some prone, some upright, many of fragmentary length, others barely rising above the surrounding rubble—all mutely telling the story of their ancient tragedy.

Yet all about the lava wastes, and even on the forbidding ramparts of Newberry Crater itself, new vegetation is establishing itself—slowly but persistently gaining ground. It is almost as if Nature had smashed things up in an uncontrolled fit of temper and then, dismayed at the havoc and filled with contrition, had set about making amends and repairs, patiently reclothing with verdure the seared desolation. In time—whether it be centuries or millenniums—the evergreen forests will once more encircle the black slopes of the dead volcano.

was engulfed by molten lava, the wood burned away, leaving this perfect cast



▾ A SHATTERED CAST: epitaph to a one-time forest patriarch. In the background is new growth—a promise that evergreen forests may one day return to the slopes of the dead volcano

◄ THE MARMOT BOWL in winter. Beneath this blanket of deep snow the marmot village lies sleeping. After seven and a half months in darkness the animals will emerge

THE TRUE MOUNTAINEER

No one glimpsing a rare marmot in the Olympics today would dream that once they were the most playful, noisy, and sociable of wild animals in their peaceful villages above the clouds

By LOIS CRISLER

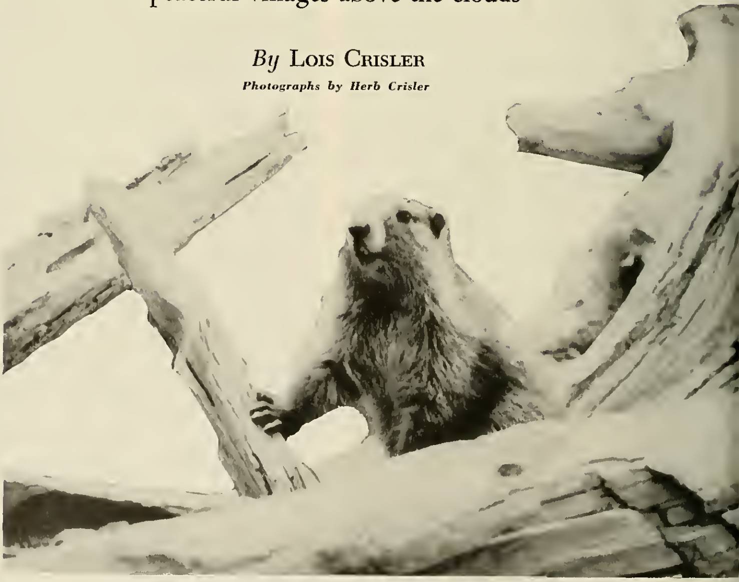
Photographs by Herb Crisler

THE marmot is less cut out to be tragic than almost any other animal. For a tragic figure I would pick a big bull elk, an antlered king, going off into the mists of death, proud and alone. Yet it is the furry, romping, wholehearted, stubby little whistling marmot who has seemed more ominously shrouded with the tragic veil.

I saw him in his golden age and did not know it. I lived with the marmot for a year in a little secluded backwater of the Olympic Mountains in Washington State and got well acquainted with him and his ways. I did not know this was only a pool left in the ebb tide of his glory. I had to learn how he lived in his golden age to feel the pathos, the strangely tragic status of this unconsciously comic little animal.

For most of a year my husband Cris and I lived alone in a lookout on the tip of a mountain more than a perpendicular mile above the salt blue Strait of Juan de Fuca. We were up in a choppy sea of mountains, with the white heads of the Olympics on three sides of us. Down from the lonely conelike tip of Hurricane, our own peak, swept alpine meadows that were a whistling metropolis of the vanishing marmot.

Cris and I, in a glass-girt lookout, were the only human beings for fifteen miles. Our neighbors were the marmots. On the rock in front of the lookout door was Molly Grumpy. Down on the lip of the drop-off into Griff Creek basin were the Twins. On the other side, on the slanting drop-off into the Marmot Bowl, we found the Babies. Then there were the *hoi polloi* of marmots, the general run, whose burrows filled the space between our favorites.



▲ "WANNA PLAY?" this marmot seems to ask. At work, the marmot is industrious, but at play his elflike, comic personality really finds expression

There were plenty of other animals around — snowshoe rabbits, deer, chipmunks, bear, even elk. Cougar crossed the mountain pass below us to the north. The coyote gave us an equally wide berth but left its cautious tracks down the ridge to the east. All these we saw at intervals.

But the marmots were property holders, with investments of labor. When we wanted to see a marmot, we had only to look out one of the 24 windows belting our 13 by 13 foot living space. When a marmot whistled, we looked too, just as the wild things did. We wanted to see who had upset the marmot—a bear, wildcat, or coyote.

The first time I began really to get acquainted with the marmots, Cris and I stood and laughed for ten minutes. Two of them were playing a game on the rounding lip of their burrow, while a third watched from the hillside above. The game was complex. It seemed to be a mixture of boxing and rolling downhill. I could not figure out which was the climax, to the marmots. The two tawny, fur-overcoated players would stand on their hind legs boxing. Then they would haul off and wait alertly for an instant, then the furry chests would fly together in a clinch. A grunt, sometimes a squeak that certainly meant, "Ouch, no fair biting," then the furry pair would tumble over and roll headlong down the side of the burrow, which was already worn bare.

To us this was the funniest part of the game—their spirit of abandonment in that headfirst, end-over-end tumble. The marmots couldn't wait to get going again. They would leap to their feet, traveling this time in normal marmot fashion, on all fours, and fly to the lip again, one ascending on each side. There they would rise on hind feet and gravely and eagerly waddle toward each other, to slap, to clinch, to make the roll all over again.

That roll, I believe, was the cream of it—a double roll and sometimes a triple; for the third marmot, which seemed to be the mother, could not resist jumping down, throwing her furry body onto the boxers, and rolling over and over with them in a reckless heap of fur down the worn hillside.

We have watched marmots coast on snow. Free movement that costs no work is fascinating to a wild animal. They have no sled, no skis. We have watched a marmot deliberately shove off and coast on its rump down the soft spring snow, or throw on the brakes when running down the snow and skid for ten feet.

Probably no adult wild animal loves a romp more than a marmot or indulges in one oftener. It was a laughing village that we watched, spread out below our lookout windows. The apparently sober-minded marmots were good for dropping work and putting on a foot race any time. If one overtook the other, they rose to box. Their supple bodies stood up slim and smooth as those of ballet dancers. They pulled high, sank low, and clinched, in a quaint pattern of movement sometimes as rhythmic as a dance.

The invitation to the dance was given by one furry paw-pat on the shoulder of a possible partner. The invitation was never scorned. The two taut, erect bodies formed a perfect arch, noses and forepaws together. Then, pushing away with their paws, each marmot curved backward, heads backward too! They swung together and their buck teeth clicked—the castenets! Then one would break away and

▼ The Olympic marmots are the largest, weighing fifteen pounds or more. From the front, they look deceivingly bulky, but from the side, when the marmot is in motion, the body shows up skimpy and narrow

◂ A MARMOT LOOKOUT: for basking in the sun and for viewing the world roundabout. The marmot ascends rocks as easily as cats climb trees, but he grips the surface instead of clawing it

▾ PROBABLY no adult wild animal loves to romp more than a marmot. These apparently sober-minded animals are good for dropping work and putting on a foot race any time

▾ SETTING UP "SHOP" beside some marmot burrows. Hibernation begins in September, and the sleepy animals reappear sometime in May

run, hissing if the other almost caught him. Boxing or square dancing, the marmots loved it.

These marmots in the Olympics are the largest—bigger than a tomcat and weighing fifteen pounds or more. From the front the marmot looks deceivingly bulky. His hide seems to hang in folds over his shoulders, like a fur cape. But from the side, as he stalks away with his stiff-legged marmot walk, his body shows up skimpy and narrow, with neither chest nor stomach curves.

One purely marmot touch is his gait. The marmot moves fast, with quick listening pauses. After each pause he gives himself the green light by flipping his tail up over his spine—a stop-and-go signal to himself!

Marmots are rodents, big cousins of the woodchuck—not like cats, not like dogs. They ripple themselves against a rock, stroking their fur apparently with a cat's pleasure, but when they climb, it is not like a cat. They ascend craggy rocks as easily as cats climb trees, but they grip instead of clawing. All four of their black-fingered paws are as clever as little hands.

They conduct "post offices" but not as dogs do. The marmot stands up by a post and with his two long, curved, rodent upper teeth, chisels a tooth mark as high as he can reach—his letter to the next marmot. Two or three of the small gray telephone poles leading up to our lookout had been undercut by them in this way.

Most people think marmots make only one sound—the famous warning whistle. But actually they can utter most of the sounds small dogs or cats can make. They mew, growl, hiss, and bark. When a marmot finds itself hopelessly penned, with no exit, it cries like a baby.

The whistle of the marmot sounds human. A party of the Seattle Mountaineers Club were being guided across a snow field in the fog by their leader's police whistle. They became utterly confused when the marmots also began giving come-ahead or wait signals.

The marmot whistles with its whole self, like a sea gull or a bull elk. Its sloping shoulders, in the loose fur overcoat, shrug together. The whistle is for intruders. If one marmot spies an intruder at a safe distance, he whistles. Then all the marmots fly to their burrows, hind ends flopping ridiculously, and pause on the lip to look for the enemy. If he is too close, they drop out of sight without another peep. If he is a safe distance away, then one or more of the marmots, standing erect on the mound at the lip of the burrows, settle into a rhythmic series of whistles until their perturbation dies down.

But most interesting of all are the cat-and-dog discussions among themselves, when the marmots think they are alone. On two successive days Cris and I watched two marmots apparently trying to dislodge an intruder from a crevice at the back of a small platform on the side of a crag. The intruder could back into the crevice far enough so that they could not drag him out. The two whirled around, reached for him, climbed over the rocks looking for a back entrance to his hide-out, then leaped down at the front of it. The first day, the penned-in one cried. The second day it growled. From all three came a loud medley of sounds — mewing, growling, fussing.

In June, marmot life is at its peak. The village is wide-awake after hibernation, and there is plenty of juicy food in the alpine meadows. The animals work with passionate intentness, cutting hay and carrying it in long whiskery chopfuls to the burrow to reline it, dragging up damp worn winter hay from inside and dumping it off the lip of the burrow.

The marmot is a vegetarian, and he finds many a tidbit even close to the snow. He sends the earth flying up in a stream from behind his paws as he burrows for succulent roots or digs up shining white wild onions by the dozen. He stands up, holds the bulb in his "hands" to nibble off the rootlets and sometimes even to eat the onion, though he often discards it. The alpine flowers that are spread to the sky in fabulous gardens above timber line are also devoured by this little clown—rosy douglasia, the delicate, red-veined white miner's lettuce, and honey-hearted mountain phlox. His chops work with feverish speed. He stands up to grip the blue lupine spikes and pull them to him to eat. He nibbles lichens off the sun-facing rocks.

▲ HOME of the true mountaineer: the Olympic Mountains. Here, above timber line, the marmots live the year round

One of the strangest, most elfin things I ever saw was Cris playing with the wild marmots one June evening. For two weeks he had done nothing but film marmots, from breakfast or before till the late afternoon sunlight was too dim for color movies. The Twins were his stand-by. They got to know him.

The sun was near setting, and I knew I would not be disturbing his subjects when I went to look for Cris. I heard a scrambling, a rush from the alpine fir scrub beyond the Twin's dugouts, and a low exclamation from Cris. I could not see a thing. Then the soft rush again, a half-voiced marmot squeak, a grunt from Cris, and into the shadowy circlet of meadow they came, none of them knowing I was around. I stood still. All three were chasing each other. It looked like the good old marmot game of tag, varied into hide-and-seek. Cris jumped to one side, the marmots darted under the scrub on the other. He made a little move toward them. They ran a foot or two farther, then turned and went pellmell toward Cris again, quartering past him more intent on each other but in some tolerant, elfin way accepting the man as part of the setup.

Marmots are peaceful. Once only we saw Molly Grumpy fight. The battle was for her property rights, and she fought hard. Naturally an animal with a burrow, grazing meadow, dodge holes, and lookout rock has a sense of property. In the spring, when the marmots first come out of hibernation, grazing boundaries have to be established, and there are a few intense battles, like that of Molly whipping out a greedy intruder.

Molly Grumpy spent hours on her favorite rock near our own door. When she let me walk right past her without dropping out of sight, I felt as pleased as if I had made an A on examinations. She relaxed onto the top of the rock, flattening her body over it like a small tawny fur rug. But she had her limit of toleration. If I let water hiss on the hot stove or clattered a pan in the vast silence of the lonely mountaintop, she whirled around abruptly and directed her attention to me.

On cold windy days, she might sit hunched like a cat for an hour at a time. Poor days for relaxing out-of-doors, I thought. But on these days she thrilled me. The small blunt triangle of her head was reared against the vast blue triangle of Mt. Angeles. Mists fumed up white from the canyon below and drove past her. Her short fur blew up backward along her spine from the wind off the Pacific—an indomitable little mountaineer whom rough weather never drove "downstairs." Above timber line was her home, twelve months of the year.

In the winter when I skied down into the Marmot Bowl and stood silent on my skis, it gave me an uncanny feeling to realize that beneath my feet were these living animals. Around me was the barren, bitter beauty of mountain winter. The unbroken snow rolled deep over the burrows. There was a fine glitter in the air from sparkles of snow blowing off the cornices along the mountain ridges.

Our own winter at the lookout was lonely. Three impossible sounds were a rooster crowing, an automobile horn, the knock of a human being at our storm door. Winter was dramatic. It was a fight. Spring was the difficult time, for spring was monotonous. It never came. I was tensed to endure the winter, but then I wanted change. Yet still the storms came, the winds blew, the clouds that in winter had preferred to pile out over the strait now hugged the mountain ranges, and through their torn places I looked down with wistful longing at the rich green, 4000 feet below. Down there it was warm. Down there the sun shone and gardens were starting.

But up in our thin, lonely world of blue and white we one day had one of the dramatic experiences of our lives. We saw the marmots dehibernate.

Cris was on night duty. I went off at 1:00 A. M. and usually slept till 9:30. But on the eighth of May, Cris could not wait for me to awaken. He came down to the bedroom, which was in a shed below the lookout. He is a very soft-spoken man, but now there was excited pleasure in his every move as he said casually, "We got company."

From fast asleep I sat up wide-awake: "Who? Where?" He smiled a little and pointed out the window. Down on the white expanse of the marmot meadow were round black holes. Near each hole sat one or two dopey little dark figures. The marmots were out!

Cris told me that the holes had been there when it first began to get light. The little beasts had dug themselves out between evening and dawn, presumably because this was the first warm night of spring. We kept our eyes on those dopey little figures as we got breakfast and ate. They hopped around a little, changed position, and even moved

▼ SOCIALIZING IN THE SUN. Marmots can utter most of the sounds that small cats and dogs can make. They mew, growl, hiss, and bark; and when hopelessly trapped they cry like a baby

➤ A MARMOT HALTS for warning sounds. His gait is fast, with quick listening pauses, after which he gives himself the green light by flipping his tail over his spine

⮟ BOXING, marmot style. They pull high, sink low, and clinch, in a quaint pattern of movement sometimes as rhythmic as a dance

to the other side of the burrow. But mostly they just sat as if drugged. About 10:00 A. M., they went in and did not reappear till the next day. We went down to investigate the holes. We estimated that in one place the marmots had dug up through ten feet of snow.

These marmots had last appeared the previous fall, on September 26, when the mountain meadow was still hot and sunny but devoid of moisture. Every juicy green blade had been stripped by grasshoppers or had dried up. For over seven and a half months these marmots had not been seen by human eyes.

It was a day or two more before the marmots in deep-snowed Griff Creek basin, just below us to the north, came out, and before Molly Grumpy emerged from her den beneath her lookout rock. Daily the black circles of the holes widened, the snow level sank. But on May 18, I could still dangle my ski pole by the strap, with my wrist at snow level, and the point barely touched ground down inside the perpendicular snow funnel. Four feet eight inches!

Only gradually did the marmots come to life. But after a few days they were briskly establishing snow trails—up from Griff Creek basin through a gap they made in the cornice, to reach some early meadow grazing on the south side of the lookout, and from each burrow to reach their own favorite resting lookouts and dodge holes. The snow trails coincided with the permanent trails now thawing and coming to light, worn four inches wide among the tufts of meadow grass.

These cheerful marmot villages near our lookout were, as I say, a backwater left from their golden age. When we left the lookout and went into the interior of the Olympic wilderness, we discovered that the marmots there were in trouble. The interior of the Olympics used to be a sea of marmots. Forest lookout men shot them for sport or as targets. One claimed to have shot 300 in one summer. And still they were plentiful. Hunters shot them because they alerted the deer. We saw a marmot cheat a hawk out of a grouse by whistling the alarm just as the hawk dived. The grouse made it to cover by the down of her feathers!

But for nine successive summers now, from June to October, Cris and I have ranged beyond the trails in the interior of the Olympics. We see scores of empty marmot burrows—bushes taking root at the mouths, cobwebs across the doorways. But in a whole summer we see no more than two or three marmots in the interior. They are in desolate places where the snow lies especially late and where vegetation is not abundant. They are silent and playless. No one glimpsing a rare marmot now would dream that once they were the most playful, noisy, and sociable of wild animals, in peaceful villages above the clouds.

Villages persist near places frequented by human beings — near lookouts and ski areas. But in the interior, the last village we saw was a small one in 1945. We saw a coyote a mile away. Since then there have been no more marmots there, while coyote signs are frequent, and each summer we glimpse one or two coyotes in that territory.

What is happening to the marmots? If all the marmots in the Olympics were disappearing, one might suspect an epidemic. But they do not die out near lookouts and ski areas, which the wary coyote shuns. Probably bear, wildcat, cougar, hawks, wolves will all take a marmot if they can get him. But these are all his traditional enemies,

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and he prospered in spite of them for centuries.

I had a rare experience once. I watched a wolf hunting marmots. The marmots did all right. The wolf must have been a young one. He had utterly no strategy. He saw a meal standing bolt upright, a yellow post at the mouth of a burrow, advertising itself by whistling. It looked so permanent and so accessible that the wolf made a rush at it. Just as he neared his meal, it tumbled out of sight. The whistle was taken up from other parts. The whole marmot community was in an uproar. Meals to the right of him, meals to the left, all bidding for attention, but not a single meal to eat. The wolf rushed wildly from one to another of the widely-spaced holes till he must have been exhausted—but still hungry.

We may have seen a cougar hunting marmots once. It was in the summer of 1948, and we had discovered two marmots together in the interior of the Olympics for the first time since 1945. They were in a wild, high basin off Mt. Ferry. We saw them in July and again when we passed that way in August. In September as we came down off the snow into the basin, we were looking for our marmots when, at almost the same instant, Cris and I saw a cougar near their burrow. Apparently it had been keeping a menacing vigil by the burrow. Surprised by us, it stood with its forepaws against the rock crag near the marmot hole, its head turned over its shoulder watching us. The next minute it swallowed the mountainside with great leaps and disappeared over the sky line. Two marmots alone are very vulnerable.

In their villages, marmots are fairly safe. Their safety diminishes by geometric progression with the demise of each potential lookout, because they may have to run 100 yards or more for food. And if intercepted by a predator away from the burrow, alas—they cannot run very fast.

The first week of July, 1947, we camped near a lookout rock and den of a marmot that must have come out of hibernation quite recently. His tawny fur still carried a ragged brown band of the hibernation coat. Late-lying snow surrounded his rock and covered the slopes below it. The marmot had to run quite a distance over snow and rocks to reach a patch of vegetation on the ridge above. For the entire week we camped there, we saw him daily. Though he was silent, he was trusting. A month later we camped in the same place, but there was no sign of the marmot. There was fresh coyote spoor by the lookout rock.

The coyote is not native to the Olympics; it was first noted there in the early 1920's.

Three things we notice: the appearance of coyotes in territory new to them; the simultaneous disappearance of marmots, rabbits, and grouse; then "deadness," with neither coyote nor marmots.

Will the coyote eat himself out of the country? He ranges far and is versatile, eating grasshoppers, green huckleberries, and even their blossoms, though his flanks stick together on that famine fare. He is probably in the Olympics to stay.

Is a Government hunter the solution? The gossip behind the scenes is that with trap or poison the Government hunter first kills out every other smaller animal in the country before he gets the wily coyote. If this is the case, the remedy is certainly worse than the disease.

The October after we left the lookout, Cris and I were in the interior, beyond the trails, hurrying along a ridge above the dark blue canyon of the Hoh River, 4000 feet below. Clouds were low over the glaciers on the Olympus Range opposite us, and we were anxious to get out of the mountains. We saw a marmot, erect on the sky-line ridge ahead of us. He was watching us but in silence, motionless. There was something strangely pitiful about him, and I could not tell what it was. Surely, I thought, his companions must already have gone into hibernation. This one must be late; he will "go in" shortly. But there were no used holes near by. He was silent, alone. He seemed to be traveling.

NATURE'S Record Fasters

Nature's champion fasters make a reducing diet look like a feast

By Frank W. Lane

I'VE undergone three fasts in my life—one of fifteen, another of nineteen, and a third of thirty-two days. Generally I existed on fruit and vegetable juices diluted in water, but during the longest fast I lived for a fortnight on water only. At the end of the 32 days I had lost 27 of my original 130-odd pounds. Incidentally, at no time was I confined to bed, and during most of the time I was able to go out for walks.

After these experiences of fasting I thought I knew something about the subject, but I have since learned that, compared with some of Nature's champion fasters, I hardly know what the word means. My fast was, at most, only partial (I had water and nourishing juices) and was reckoned in days. There are some creatures of the wild whose periods of fasting are reckoned in years, and during that time they don't even have a sip of water—let alone a drop of carrot or grape juice!

Here it is necessary to deal with the extravagant stories that occasionally crop up concerning frogs and toads that are said to be found by workmen while demolishing old buildings. The heading of one such account in front of me now reads: "Toad Set in Concrete 20 Years Ago Rolls Out, Alive and Well." Another newspaper report I have seen alleges that a frog was found in a 60-year-old brick wall. The workmen declared that they could see no way for the frog to have gotten there unless it had been there when the wall was erected.

I say without hesitation that all reports of toads or frogs living for 60, 20, or any number of years entombed in ancient buildings, concrete blocks, brick walls, or what have you, are untrue. Experimental biologists know how difficult it is to keep frogs and toads alive in captivity even under the best laboratory conditions. A constant source of moisture is vital to keep them alive. In dry air they die in a few hours. How impossible, then, would it be for them to live for years (not to mention decades) under the unnatural conditions of incarceration in some impermeable substance from which water, food, and air were excluded!

If reinforcement of these arguments were necessary, it is provided by the experiments carried out as long ago as 1825 by the Rev. W. Buckland, Professor of Geology and Mineralogy at Oxford, England. He procured a dozen boxes of sandstone fitted with airtight glass covers, and an equal number made of limestone. Each box was provided with a toad, and then all were buried under three feet of earth.

Thirteen months later the boxes were dug up. All the toads in the sandstone boxes were quite dead. In the porous limestone boxes a few toads were still alive. The surviving toads were again buried, but before the end of the second year they were all dead. As the result of these and other experiments involving wood, the Rev. W. Buckland concluded: "There is a want of sufficiently minute and accurate observation in those so frequently recorded cases where toads are said to be found alive within blocks of stone and wood, in cavities that had no communication whatever with the external air."

How, then, is the persistence of the myth of the "walled-up" frog and toad to be accounted for? Doris M. Cochran of the U.S. National Museum, who has made a study of this subject, explains that these creatures, especially toads, can and do persistently hide in small holes and crevices. To a toad roaming about at dusk, the bottom of a deep excavation has no doubt often seemed an ideal spot. The summer's heat and dryness has probably often driven toads and frogs to burrow into chinks under old walls or to wander down the entrance of mines into the dark, cool, and moist surroundings—conditions imperatively necessary to an amphibian's existence.

And when the poor creature is found by a none-too-critical workman, and the story is written up by an all-too-credulous reporter, there is another entombed toad story to titillate the fancy of the newspaper reader and bring an amused smile (if nothing worse) to the face of the professional zoologist.

But now for the *real* experts in fasting. The Natural History Museum in Kensington (London, England) once had on exhibit, securely gummed to a metal tablet, an

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Egyptian desert snail. In its natural habitat, this snail is accustomed to lying dormant for long periods, waiting for the refreshing water that will revive it, perhaps after a long interval. Conditions in an arid museum must have been enough like the Egyptian desert to keep this particular snail in a state of prolonged dormancy. But one day, in the dim recesses of whatever serves an Egyptian desert snail for a brain, obscure processes began to work. The snail woke up after an interval of almost four years (from March 25, 1846, to March 15, 1850). One of the Museum officials, peering into the snail's case, noticed that the snail had formed a new membrane over the mouth of its shell. Scarcely believing his eyes, he carefully removed the snail and put it into tepid water. After fifteen minutes the snail was moving about, and the next day it ate some cabbage. All this happened many years ago, but I was pleased to learn, after I had mentioned this story in a broadcast, that a descendant of the man responsible for recording the incident in the scientific archives (W. Baird) wrote to the BBC confirming in general what I had said.

Another creature capable of being revived after a prolonged drought is the African lungfish. Lungfishes are also found in other countries, but it is the African species that I am concerned with here. About a yard long, and looking something like a conger eel with a flattened rear end, the lungfish lives in small streams and swamps which, under the African sun, sometimes dry up completely for months on end. That would be the end of the lungfish if it were made like an ordinary fish, but it has several anatomical peculiarities that enable it to survive prolonged drought and emerge again alive and well when the rains once more bring a watery paradise.

As the water begins to disappear, the lungfish estivates in a mud cake, in which there is a small hole connecting it to the surface and air. It breathes in and out about once every two hours. It provides its body with the small amount of sustenance necessary for its vital functions by absorbing its muscle tissue, sometimes reducing its total body weight by one half.

The lungfish preserves its body moisture because, during estivation, it is covered by a cellophane-like wrapping that is absolutely impervious to water and air and thus to evaporation. When the rains come, water runs down the air hole and enters the fish's mouth, which is the only part of its body not covered with the film. The moisture slowly awakens the fish, and by the time the rains have softened the surrounding mud, the lungfish is ready for action.

Under scientifically controlled conditions, lungfish have proved themselves able to live in their mud cakes for over four years and then be revived by moisture. Even after such a prolonged fast a lungfish will be swimming about and eating voraciously within a few hours.

Bed bugs and ticks are unlovely creatures, yet they cannot be disregarded when fasting is considered. A bed bug lives only on blood. Its beak is adapted for puncturing skin and sucking blood and for no other method of feeding. Meals may be at infrequent intervals; and for the species to continue, the bugs must be able to withstand starvation for a long time. I do not know the maximum period, but according to the publication *The Bed Bug* (His Majesty's Stationary Office, 1949) live bed bugs have been found in cubicles of a lodging house that had been vacant for three years.

In a letter to me, W. L. McAtee, formerly of the U. S. Fish and Wildlife Service, writes: "In the town where I grew up was an old soldiers' home, and it was reported that some of the inmates there had bed bugs which they had kept sealed up in bottles for various terms of years (five and ten, I recall), and I remember seeing at least one of these specimens which could still move but was practically translucent."

The habit of ticks is to wait on grass or other vegetation until a warm-blooded animal brushes past, and then to cling to it and gorge on its blood. But a tick may have to wait a long time before a suitable host comes conveniently near; and to survive such periods, the parasite must be remarkably resistant to starvation. It is. The Russian authorities on ticks, Pavlovskii and Skruinnik, have reported that one species *(Ornithodorus papillipes)* can live without food for seven and a half years. Even this may be well below the maximum for ticks, for as Ruth Crosby Noble points out in her book, *The Nature of the Beast,* J. Baron Uexküll and G. Kriszat claimed in 1934 that some ticks can live for eighteen years without eating!

Eighteen years without a meal—but it is still a long way from the maximum period that some creatures can exist without food or water. Long intervals of dormancy are possible only when the animal is thoroughly desiccated or when it has some provision for protecting itself from drying, as in the case of the lungfish with its "cellophane" wrapper or the snail with its diaphragm over the mouth of its shell. It is not so much a case of lasting without food as without water. The food requirements are reduced almost to nothing.

As far as my researches have gone, the record holders in food and water abstinence are some lowly creatures known as nematodes, a class of small worms, many of which are parasitic. It is possible that some animals even lower in the biological scale may be able to resist starvation even longer, but I am not concerned with microscopic forms here.

It has been known for many years that nematodes can live for years without eating. They sometimes go into a state of dormancy, or suspended animation, but if moistened they frequently revive. In the eighteenth century some of these worms were observed to lie dormant for 27 years and were then revived. According to Prof. Heinrich Simroth, a nematode kept in galled wheat at the Zoological Institute of the University of Leipzig revived after 28 years of dormancy. It is probable that this nematode might have remained dormant even longer, but unfortunately an overeager laboratory assistant, presumably thinking that the preserving alcohol had evaporated, poured some into the specimen jar and promptly put an end to the experiment.

This 28-year dormancy and revival stood as the record until 1945. In June of that year, two United States Government experts on nematodes, G. Steiner and Florence E. Albin, were examining the leaf of a rye seedling. On it were several nematodes in a dormant state. When these were moistened, five of them, two females and three larvae, revived. Records showed that the rye leaf had been preserved since the autumn of 1906. As nematodes are unable to move around on or in dry material, it meant that these five lowly animals had existed without food and water for nearly 39 years.

Surely 39 years is the all-time fasting record—or is it? After the surprises I have had while collecting material on Nature's fasters, I am not going to claim even *that* as the record time that any animal can resist total starvation. Zoological truth is certainly more unbelievable than the nature-faker's fiction.

BORN ALIVE *Continued from page 419*

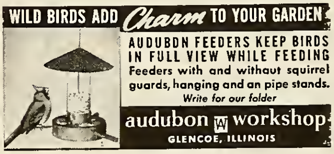
is the fastest tree traveler in the world. It mates in April, and the young are not born for almost twelve months. Whether the mother's suspicions are justifiable or not, she does not tolerate a male anywhere near her helpless babies. Within a few days after their birth, she leaves them for a night or two in April and mates again. After that she returns to her brood and nurses them through the summer as a good mother should, with the next batch already started in her womb.

Bears and bats have had their own problems and found their own solutions. Among the bats of northern countries, the embryos develop slowly in the fall and may actually stop development during the cold of the winter hibernation. While actual development requires only about three months, birth does not occur until the following May or June. At this time, the mother bats usually collect together. Each hangs by her feet and thumb hooks and spreads her leg membranes to catch the baby as it is born. During the day she hangs head-down, folding her blind, helpless sucklings to her breasts with her wings. At dusk she may fly out, taking her family with her. This can be a big load for a flying animal, for the babies may amount to more than a quarter of her own weight.

Bears generally find a den for the winter and spend much of the time asleep. They mate in early summer, and in the north the pregnant females go into a kind of twilight sleep. The cubs are born at the new year after seven or eight months' gestation. At this time, black bear cubs are blind and helpless and weigh less than half a pound. They know enough, however, to find the milk, and the mother sleeps on, possibly not even having awakened during her childbearing. Not for another 40 days do the cubs' eyes open and their teeth begin to cut, and it is spring before they can toddle out with the mother. Then for a year or more they go hunting with her, but during the second summer she takes a new mate and the youngsters acquire a stepfather. The reorganized family then travels together for about another year before the final breakup.

Birth itself is a somewhat arbitrary interruption of the course of growth, and the small size and seemingly premature birth of bear cubs is no disadvantage when compensated by the warmth, safety, maternal affection, and intelligence of the mother. This is even more strikingly shown among humans and other anthropoids, where family life has reduced infant mortality to the lowest rate for the animal kingdom.

A final contrast concerns not so much the manner and duration of life before birth, as the rate at which living material is produced. Human beings and the great whales are both mammals, with warm blood, live birth, and teats for suckling. Both carry their young for close to nine months. But one has the slowest and the other the greatest rate of growth yet known. At the end of nine months of development there is only a foot or so of human baby, and the next twenty years rarely brings a total of more than six feet. But the living substance is so organized that it may continue for a century, discover and split an atom, or create a symphony. The giant blue whale may be seventeen feet long at birth and fifty feet a half year later when it is weaned. In two or three more years it will have reached a length of seventy to eighty feet! But this blubber and brawn, shaped like a fish, lives little longer than a dog, and its fantastic rate of growth highlights the unique slowness in the forming of human protoplasm. Somewhere in the nature of this slowness lies the secret of our own humanity and the hope of our yet evolving.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BOOKS

Continued from page 391

A NATURAL HISTORY OF TREES

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606 pp., 163 drawings

PROBABLY no members of the living green world have such a wide popular appeal as do trees. Although man has found it necessary to cut down and clear out forests in order to live, one of his first thoughts after building his home, paradoxically enough, is to landscape it with trees. And should man wish to learn something about the trees that he has planted, something about their range or habit, uses or history—in brief, a bit of their natural history—he should make certain that this volume by Donald Culross Peattie is available in his home library.

Actually, this is the first in a series of several volumes which will discuss all the important species of trees (no hybrids included) of our continent north of Mexico. When complete, the set will be a sort of popular edition of the classical *Silva* of Sargent. This present volume encompasses northeastern North America (comprising approximately the region east of the 100th meridian and north of the 35th parallel), an area richer in trees than any other within the boundaries proposed to be covered in the set. For each species of tree Mr. Peattie has given us a happy blending of accurate scientific description combined with a fascinating essay on its natural history. Each of these essays is in the author's delightful style, which has earned him an enviable reputation as one of our best natural historians. To make this work even more widely useful—as a manual for identification—there has been added a general key to the species of trees based on characteristics of foliage. A fine glossary and indices to both scientific (the most recent terminology is used) and English names are also present. "Gilding the lily," as it were, are the beautiful and accurate wood engravings of Paul Landacre.

If the nature lover, whether amateur or professional, can afford but a single volume on the trees of northeastern North America, then this should be it!

W. H. Hodge

THE BIRDS OF ROCKY MOUNTAIN NATIONAL PARK

- - - - - - by Fred Mallery Packard

Rocky Mountain Nature Assn., 75¢
81 pp., 17 figs., 1 map

A FEW years ago (1945, *Auk*, vol. 62, pp. 371-394), Mr. Packard published a list of the birds recorded from this region that lies in the mountains of northern Colorado. The present booklet expands and brings the list up to date, placing it in a format suitable for pocket use by visitors to the park. Not only are new records added to the list, but brief diagnostic characters of each species or subspecies are given as hints for their identification. There is a sketch map of the park region and a number of fine line cuts of a few of the birds by Roger Tory Peterson.

Mr. Packard has used care in the preparation of the list. All authentic records of past years have been consulted, together with his own observations. No sight records are accepted unless supported by a specimen taken in the park region or in the Denver or Boulder regions and unless the circumstances of observation and the competence of the observer are satisfactory. Some immediately adjacent terrain is included in the area of the list, just outside the official boundaries of the park. The notes on local distribution, as in the article in the *Auk*, give the inclusive dates of regular occurrence or, in the case of rarities, the actual dates of record.

The booklet should prove very useful for visitors to the park, who are invited to report any additions or unusual observations to the Rangers without delay, so that supporting evidence may be obtained while the bird is still in the neighborhood. With this co-operation, the list may be expanded in the future.

John T. Zimmer

LETTERS

Continued from page 386

courses than are the other owls of the United States. It frequently feeds upon crawfish and frogs and, if an opportunity presents itself, upon fish. One naturalist found that young Barred Owls quickly learned to catch and eat live fish placed in a dish of water in their cage.

"In Africa and southern Asia there are true fishing owls. They have unfeathered legs; the claws are very sharp and have cutting edges; and the soles of the feet are covered with prickly outgrowths to aid in holding the slippery prey. These adaptations for catching fish are very much like those of the Fish Hawk or Osprey. Pel's Fishing Owl, which lives along the Congo River and elsewhere in Africa, is the finest and most powerful member of this group. According to Dr. James P. Chapin, the African natives consider this such a noble bird that only chiefs or their immediate relatives are permitted to wear its plumes as ornaments."

From a New Jersey physician:

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◀ These Ground Squirrels look as if they were rooted to the ground. Ground Squirrels are burrowing rodents, which feed on nuts, seeds, corn, roots, and grubs. In their cheek pouches they transport large supplies of food to their winter holes, where they lie dormant for the season

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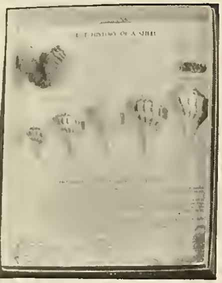

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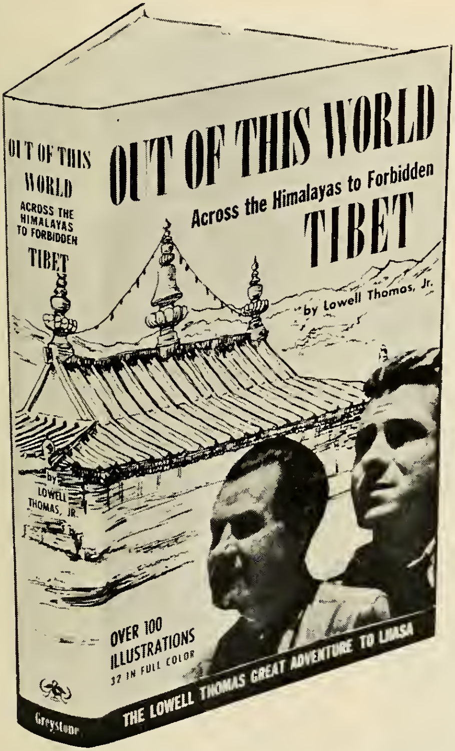

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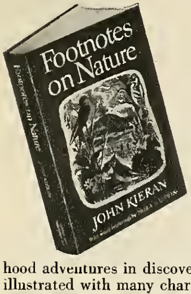

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L E T T E R S

Was there an Asiatic "Mayflower"?

SIRS:

Your article in the October issue of NATURAL HISTORY asking "Is American Indian Culture Asiatic?" is very interesting and quite convincing. Has anyone searched the early writings of Asiatic countries looking for records of an expedition, or expeditions, that might have carried the Asiatic culture to the Americas? If the cultures of Middle and South America, including the writing and methods of making books, was introduced from Asia, the introduction must have taken place after writing and bookmaking was developed on that continent. Consequently, a record might have been made of any expedition large enough to cross the Pacific in numbers sufficient to influence the culture of the Americas . . .

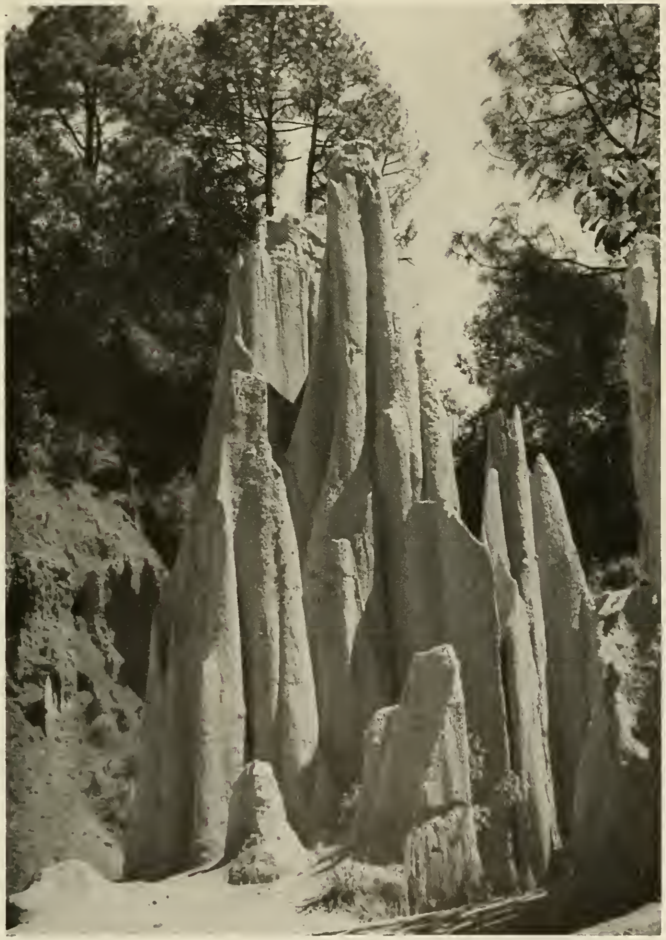
C. H. TURNER

Ozarks Chapter,
Missouri Archaelogical Society,
Springfield, Mo.

The following information is offered by Dr. Gordon F. Ekholm the author of the article referred to:

Yes, it might be worth while to search for the earliest documentary accounts of travel across the Pacific to the Americas. This would have to be done by scholars having a knowledge of the eastern Asiatic languages and of the literary sources where any such information would be found.

In Chinese annals of A.D. 499, there is an account of Fusang, an island reputed to exist in the Pacific and visited in that year by a Buddhist monk. Fusang is thought by some to have been the American continent. Other scholars believe Fusang to have been the island of Japan. The possibility that Fusang was some portion of the American continent has been proposed in a book by Edward P. Vining, *An Inglorious Columbus* (1885) and by Charles G. Leland in *Fusang, or the Discovery of America by Chinese Buddhist Priests in the 5th Century* (1875). Stefansson devotes a short chapter to this question in his *Great Adventures and Explorations* (the Dial Press, 1947).



No Termites Here

SIRS:

The accompanying photograph was taken several years ago in Guatemala, high in the mountains near Momostenango. It is not, as some may be inclined to assume, a termite nest, we are assured on good authority. It does resemble the termite nest of *Macrotermes* in Africa and the Orient. But these termites are confined to the Old World, and the details are different.

This is simply an illustration of the sculpturing power of time and weather. The soft rock has been worn down, leaving this peculiar formation, which reaches approximately 30 feet into the air. Outside of this one spot, I found nothing similar in all the surrounding territory, although there may well have been other examples.

It was said that the natives attached some special superstitious significance to this peculiarity, and that they frequently placed flat stones atop the peaks to prevent them from wearing away.

The stone is a golden yellow color and is quite beautiful against the deep blue and green of the sky and forest.

CECILIA M. EGAN

Staten Island, N. Y.

Unfertilized Eggs

SIRS:

Do birds in the wild lay unfertilized eggs as do chickens, or do they have some special instinct that causes them to lay only fertile eggs after their nesting preparations are completed? This question came up during a discussion of domestic animals, and we would appreciate any information you can offer.

GARY BRAUNER

Bronx, N. Y.

The following information is offered by Dr. Lester R. Aronson of the Amer-

Continued on page 476

NATURAL HISTORY

The Magazine of the American Museum of Natural History

F. Trubee Davison, President | Wayne M. Faunce, Vice-Director In charge of Publications | Albert E. Parr, Director

VOLUME LIX—No. 10 **DECEMBER, 1950**

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From a color photograph by Tad Nichols

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You will find Natural History *Magazine indexed in* Readers' Guide to Periodical Literature *in your library*

THE COVER THIS MONTH

This is the red torch ginger (*Phaeomeria magnifica*)—one of the spectacular flowers that will delight the visitor to the Hawaiian Islands. It is one of the many plants of the ginger family that are found from tropical Asia throughout the warm Pacific islands. This particular species comes originally from the Sunda Islands in the Netherlands East Indies.

This is a large plant, whose leaf stems arch gracefully to a height of ten to twenty feet, with the long pointed leaves alternating in two rows up the stem. The impressive flower head you see in this color photograph is supported on a stem that may reach a height of five feet or more, separate from the leaf stalk. As can be seen in the photograph, the flower head is made up of numerous red, white-margined bracts. The basal bracts are large, waxy, and flowerless, and they form a nest for a cone-shaped head covered with smaller overlapping bracts. These are arranged spirally and are accompanied by small flowers. The cone-shaped head is about five inches long.

This picture was taken in Hilo, Hawaii, where the ginger was being used to provide a very ornamental hedgerow.

Tad Nichols

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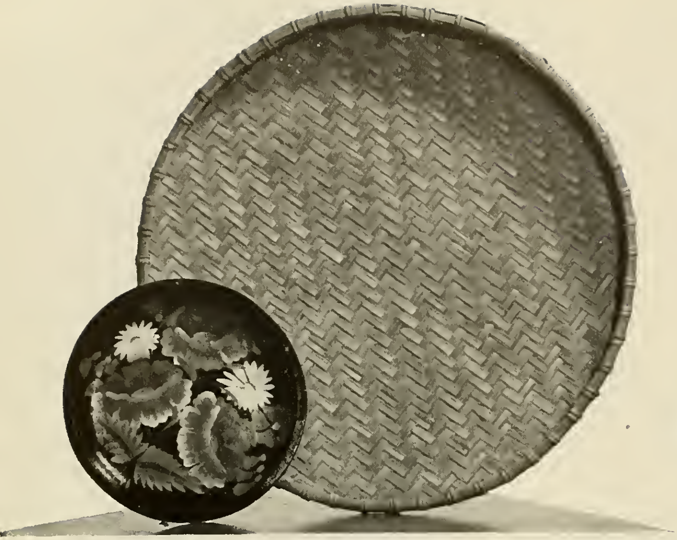

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KON TIKI

- - - - - - - - - by Thor Heyerdahl

Rand McNally and Co., $4.00
297 pp., 80 photos

READERS of NATURAL HISTORY will remember Heyerdahl's raft story,* his account of a remarkable voyage from the coast of Peru to the Marquesas Islands. The present volume, describing the trip in more detail, is so exciting and well written that it may become a classic of adventure at sea. It is excellent in so many ways that most readers and reviewers are completely unaware of the misleading and erroneous statements in the text.

Mr. Heyerdahl, convinced that the Polynesian Islands were settled from the American mainland, made the voyage to prove that it could be done. He gives the impression that there is abundant evidence in favor of his premise and that American anthropologists are too dogmatic to give him a hearing. Unfortunately, he is uninformed and misinformed on many aspects of the problem. For example, he states that the coconut palm was found in great numbers along the coast of Peru when the Spaniards arrived. Actually, Peru is outside the normal habitat of this palm. Moreover, in a land so dry that such perishable things as bean pods will survive 5000 years, not a single coconut husk, shell, or artifact made from them has ever been found.

There is evidence that people probably traveled from Peru to Polynesia in pre-Columbian times. More than 25 years ago it was shown that the sweet potato, a plant originally confined to America, had been taken to Polynesia and that the names applied to it there were of American origin. But to insist that this proves an American Indian origin for the Polynesians is somewhat comparable to claiming that they were responsible also for the populating of Ireland, because of the presence there of another American plant, *Solanum*, commonly known by a corrupted American name "potato."

There is further evidence, apparently unknown to Heyerdahl, that the Peruvians knew in considerable detail of the existence and of the position of Easter Island. It was their stories that prompted a Spanish expedition which sailed from the same port as the "Kon Tiki" 380 years previously, and, although its men did not follow instructions and missed Easter Island, they did discover the Solomons. We know, then, that there was contact between South America and Polynesia. Heyerdahl has indicated some similarities between Peruvian and Polynesian customs and legends, and we learn now that a Peruvian balsa raft can be sailed from Peru to Polynesia. But this does not add up to a conclusion that the peopling of Polynesia resulted from migrations from South America. There is more and better evidence that, basically, the peopling of the Oceanic islands resulted from movements outward from Asia.

Kon Tiki is a splendid adventure story, well worth reading. One should beware, however, of being charmed into accepting the misstatements, half truths, and poorly reasoned anthropological speculations with which it is loaded.

GORDON F. EKHOLM
JUNIUS B. BIRD

PRINCIPLES OF GENETICS

by Edmund W. Sinnott, L. C. Dunn, and Th. Dobzhansky

McGraw-Hill Book Company, $5.00
505 pages

THE "Sinnott and Dunn," first published in 1925, was for many years America's leading textbook of genetics. It dealt primarily with the essential Mendelian principles, and past editions had not quite kept up with the rapid advances in the field. The new edition of the *Principles of Genetics*, which introduces Dobzhansky as a third co-author, is thoroughly modernized. Among the many new features are three chapters on population genetics (populations, races, and species) and an up-to-date treatment of cytogenetics. Although even the latest research on bacterial genetics, biochemical genetics, and cytoplasmic genetics is dealt with, the volume has retained its character as a textbook of elementary genetics, an introduction to the field for the beginner. Over 200 illustrations help the interpretation visually. Examples from human genetics are used much more extensively than in earlier editions. The appendix contains a translation of Mendel's classical paper which laid the foundation to the whole field of genetics.

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The "Sinnott-Dunn-Dobzhansky" can be warmly recommended not only to the student of genetics but to all biologists who want to bring their knowledge of the field up to date. This includes all of us, since there is hardly a branch of natural history in which a thorough understanding of genetics is not an essential prerequisite.

E. MAYR

FISHES OF THE WESTERN NORTH ATLANTIC, VOLUME I

- - - Editor-in-Chief, John TeeVan.
Authors, Henry B. Bigelow, William C. Schroeder, and Isobel Pérez Farfante,

Sears Foundation for Marine Research,
$10.00,
576 pp., 106 illusts.

THIS impressive volume treats exhaustively of 70 species, 6 lancelots, 1 hagfish, 1 cyclostome, and 62 sharks. It really is a series of monographs dealing with all the species of these groups which inhabit the brackish and salt waters of the western north Atlantic, from Hudson Bay south to the Amazon. Its only competing predecessor, Jordan and Evermann's *Fishes of North and Middle America* appeared five decades ago and has long been out of date.

In breadth and thoroughness of treatment, in careful and detailed documentation, and in exhaustive record of pertinent published facts, the present series should remain unrivaled for another half century. The general plan is best illustrated by paragraph headings relating to individual species: Study Material, Distinctive Characters, Size, De-

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*June, 1948.

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scription, Color and Color Changes, Development, Habits, Abundance, Relation to Man, Range, Synonomy, and References. The latter, as well as numerous footnotes, are generously annotated.

The most significant focus in the overall picture is the emphasis on Habits, which offers a welcome summary and a firm foundation for future intensive studies, when new methods have been evolved for direct undersea observation.

The sequence of treatments affords excellent opportunities for interspecific comparisons. For example, the realization that in extremes of size among sharks a whale shark may reach a length of 60 feet or more, whereas the female Cuban triakis measures only a foot in length and yet may contain two four-inch embryos.

It seems to me that the authors have been very successful in producing a work which, in their own words, "should be useful to those in many walks of life —to those casually or vitally interested in the general phenomena of life in our waters, to the sportsman whose interests are closely associated with pleasure and relaxation, to the fisherman whose livelihood depends on the knowledge of where fish are gathered together, as well as to the amateur ichthyologist and the professional scientist."

The second part in this series is promised before many months and will deal with the rays and skates, chimeroids, and sturgeons.

William Beebe

BRITISH WADERS AND THEIR HAUNTS

- - - - - - - - - by S. Bayliss Smith

The British Book Centre, $5.25
163 pp., 84 illusts.

MR. SMITH is an enthusiastic bird photographer and a successful one, judging by the illustrations in this book, two-thirds of which are his own. The remaining photographs are by various other individuals who were successful in getting pictures of certain species that Mr. Smith to date had failed to capture with his lens. In addition to the photographs, there are three plates of excellent drawings of waders in flight, the work of Basil Lakes.

The text is predominantly narrative in form and contains much of the author's personal observation and experience in obtaining the portraits of his favorite birds. Several introductory chapters, in particular, deal with days (and nights) in the field and with the problems of bird photography. The succeeding chapters discuss the various waders in turn, giving something about their characteristic traits and their local occurrence if at all unusual. Lastly, there is a series of half-page descriptive sketches of each of the species concerned, giving the salient details of measurement, plumages, call notes, display, food, distribution, and the like. Each of these items is preceded by a key number, used for each of the species, making it easy to compare them with each other in respect to any of these factors.

The running account is very pleasantly written and devoid of technicalities, and it can be recommended to anyone who likes to read about the ways of birds and bird photographers or who enjoys interesting photographs of wildlife.

John T. Zimmer

TIME AND ITS MYSTERIES, Series III

by Henry Russell, Adolph Knopf, James T. Shotwell, George P. Luckey

New York University Press, $3.00
126 pp.

THIS book presents in published form the III series of lectures on "Time and Its Mysteries," given under the auspices of the James Arthur Foundation of New York University. The four contributions that comprise the book have been written by men of outstanding achievement and reputation in the fields of astronomy, geology, history, and watch making. The four essays are, needless to say, authoritative, yet they are written with such clarity of style as to make them readily understandable and interesting to the general reader.

Professor Russell discusses the problem of a time scale for the universe, describing four independent lines of evidence for such a time scale. These are: radioactivity, the time scale of galactic motions, the time scale for binary stars and clusters, and the life cycle of a star. From these lines of evidence he shows that the universe is going through a long history of transition—a history that extends billions of years into the past, and probably will extend billions of years into the future.

Professor Knopf is concerned with the age of the earth. He presents a clear and timely discussion of modern methods of dating the earth's age, especially by the study of radioactive elements. Nor does he neglect to consider, for supplementary evidence, such problems as erosion and the deposition of great river deltas, stratified or varved sediments, and the salinity of the oceans. From this discussion he shows that the earth must be something more than 2000 million years old, and he indicates how recent work on radioactivity has aided in the establishment of an absolute time scale for geologic history. The greatest single contribution of geology to

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GLENCOE, ILLINOIS

modern thought, says Professor Knopf, is "the realization of the immense length of time."

Professor Shotwell's contribution is entitled "Time and Historical Perspective." He shows how the need for time gradually developed among primitive peoples. Then he goes on to trace the establishment of calendars by the early Egyptians and Babylonians, and from there he carries the story on to Greek and Roman history. Finally, he traces the historical perspective of time through the Middle Ages and on to our own day.

The final part of the book, by Mr. Luckey of the Hamilton Watch Company, is an interesting account of developments in portable timepieces.

This book, a worthy successor to the preceding volumes of the series, should be a valuable addition to the library of anyone interested in the subject of time. Each of the four papers that constitute the volume makes a half an hour or so of excellent reading. Moreover, this book is a useful reference volume to have within easy reach. Finally, it is beautifully printed, which makes it a nice book physically.

EDWIN H. COLBERT

THE PHASIAN BIRD

- - - - - - - by Henry Williamson

Little, Brown and Co., $4.00,
276 pp., 24 wood cuts

THIS is ostensibly the story of a hybrid pheasant in Norfolk, England, but the main theme is rather the rejuvenation of the run-down farm on which the bird lived. A great deal of space is devoted to agricultural practices and the activities of the people in the neighborhood, with less attention to the wildlife, including the avian hero, "Chee-kai." The bird thus occupies somewhat the rôle of a feathered Moby Dick—as much a symbol as an active character.

It is difficult, therefore, to consider the tale as a piece of true nature writing or bird biography, and perhaps this was not the author's intention. There are, in fact, a number of things that are highly dubious. Such are the incident of the goldcrest dropping to the back of a migrating owl and falling asleep during the remainder of its journey; the pheasant attracted to the scent of planted artichokes or turning its own scent inward; a ringdove so stuffed with acorns that it could not fly! It is rather for its literary flavor than for its natural history that the book should be appraised. Regrettably, many sentences are too long and involved to be altogether pleasing, while the casually introduced words of the author's invention, not to mention the Norfolk vernacular, almost call for a glossary. There are, however, many fine word pictures that give a glimpse of countryside with which the author is unquestionably familiar.

JOHN T. ZIMMER

HANDBOOK OF ATTRACTING BIRDS

- - - - by Thomas P. McElroy, Jr.
Illustrated by Lambert Guenther

Alfred A. Knopf, $2.75
163 pp., 51 illusts.

THIS highly practical guide to attracting birds is crammed with information from cover to cover. Mr. McElroy, who is Curator of the Pequot-sepos Wildlife Sanctuary in Mystic, Connecticut, has obviously gathered information both from experience and from other publications. Of the latter, the first to come to mind is *The Audubon Guide to Attracting Birds,* now out of print. The present volume lacks the colored plates and photographs of that work, but it is more terse and has more explanatory sketches. There are specific plans for building bird houses, for selecting and planting shrubs and flowers useful to birds and pleasing to the eye, and for doing many other things designed to encourage birds.

Consideration is not limited to songbirds. One chapter is concerned with the problems of managing waterfowl, and another deals with upland game birds. There are also informative chapters on the role of predators in nature, on the care of young birds, and on bird identification. Finally, there is advice on founding a municipal wildlife sanctuary, complete even to the point of supplying tentative articles of incorporation. Although intended primarily for the eastern United States, most of the information in this handbook will be applicable elsewhere.

Anyone wishing to attract and encourage birds around his home will find many valuable suggestions in this book. Even those who have been interested in this subject for years will find new ideas to try out. My wife, for example, has decided to chisel a bird bath in the top of a small granite boulder in our rock garden—McElroy says it is easy!

DEAN AMADON

MENABONI'S BIRDS

- - Illustrated by Athos Menaboni
Text by Sara Menaboni

Rinehart and Co., $10.00
132 pp., 8 x 12 inches; 109 illusts.

MOST authorities, if asked to list a few of the leading painters of birds in America today, would include the name of Athos Menaboni. His work rarely appears in books and journals, though it adorns the walls of many homes, especially in Menaboni's adopted city, Atlanta, Georgia. The present sumptuous volume will make the work of this artist available to a much wider circle. Thirty-one full-page paintings of birds have been reproduced in color, for the most part excellently, and 13 more in black and white.

Continued on page 476

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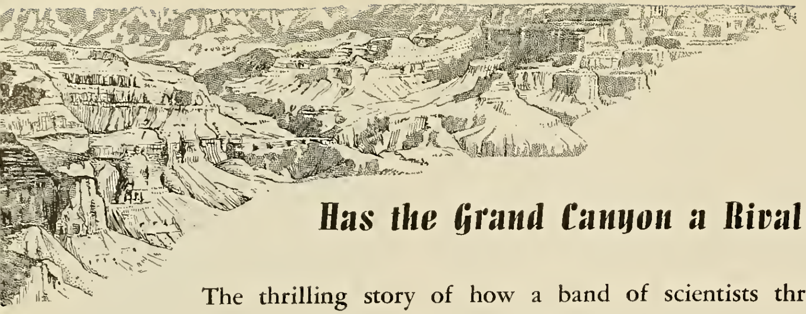
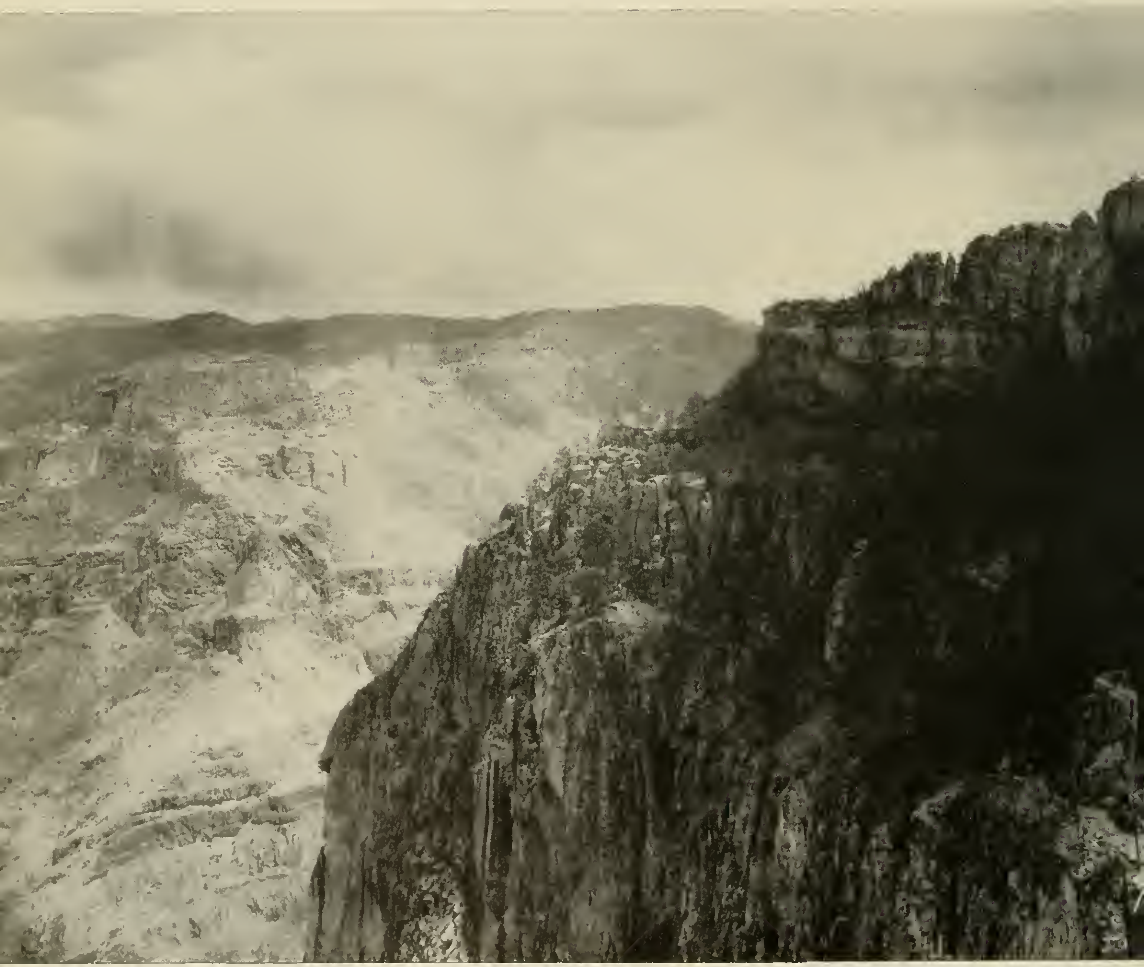


Has the Grand Canyon a Rival?

The thrilling story of how a band of scientists threaded their way for twelve days over trails known only to Tarahumare Indians to reach a gigantic canyon, reported to be deeper than the Grand Canyon of the Colorado

Th



▲ A VIEW of the Barranca del Cobre from the rim. The canyon was reported to be 100 miles long, and it was so intricate in its sculpturing that the explorers sometimes found it difficult to know which was the main gorge

➤ THE EXPEDITION'S INDIAN HELPERS. *Left to right:* Pancho, Francisco, Isidro, Juan, and Chrispine, the cook

escent into the Barranca del Cobre

By ROBERT THOMAS MOORE*

Director, Zoological Laboratory, Occidental College, Los Angeles, California

All photographs by the author

Part I

FATHER Salvatierra went to the famous canyon of Hurich in 1684. "At sight of the precipice," the venerable father is quoted as saying, "such was my terror that I . . . did not precisely dismount, but let myself fall off on the side opposite the precipice, sweating and trembling all over with fright."[1]

This canyon, better known as the Barranca del Cobre, was first brought to my attention in 1933, while I was collecting zoological specimens on the Guirocoba Ranch of Jim McCarty in extreme southeastern Sonora. Jim said he had been told it was deeper than the Grand Canyon. No white man had visited it, he said, since the padre mentioned above. Curiosity prodded me to inquire about the possibilities of leading an expedition to determine its depth, to see the cliff dwellers who inhabited its caves, and, most important, to bring back a collection of birds and mammals. The area was unexplored zoologically and might contain forms new to science.

Jim tried to discourage me. He had traveled only four days toward the canyon and said it had been the most hellish journey he had taken in thirty years of mining trips! A Mayo-Tarahumare Indian he knew had told him it would take fifteen days to get there. Knowing Jim to be a rugged "desert rat," not wont to be daunted by ordinary difficulties, I asked for details.

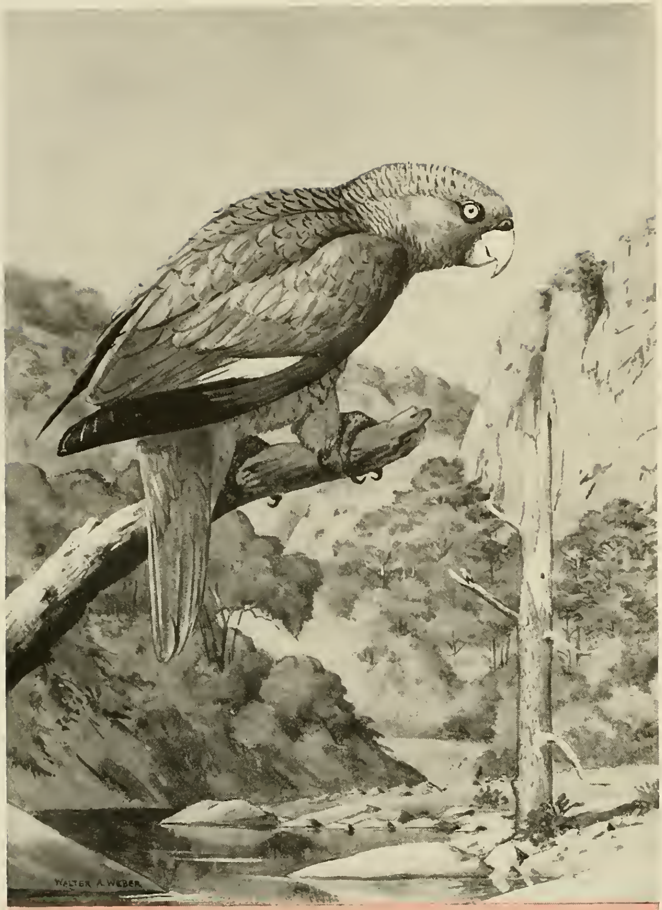
"Wa'al," he replied, eying me coolly, "first, it's heat on the burnt-up southern foothills facing the Fuerte and the sun. We'd be in that cauldron for five days while we climb nearly 8000 feet. Furthermore, it's pig pools for water for four of those days! If that doesn't poison us, the fires the Indians set to plant their corn may block the only trail! Finally, the regular rainy season may come early before we can get back, and we can't go before May, because the Chinipas and El Fuerte may be running above their banks from melting snows in the high mountains. I've known a calf-like stream to rise 30 feet in one night from a cloudburst and put you in the trees, your bedding and food washed away!"

"Anything more?" I asked, trying to appear undaunted.

---

[1] Francisco Javier Allegre, *Historia de la Compañia de Jesús en Nueva España* (Mexico, 1842), Tomo III, pp. 48 and 51-52.

*ROBERT T. MOORE, one-time editor of an ornithological publication and a breeder of silver-black foxes, is a zoologist, lecturer, author, explorer, and mountain climber. He was the leader of two expeditions to southern Ecuador, during which he succeeded in ascending Mt. Sangay for the first and only time in history. He has also led eight expeditions to Mexico. On these field trips he discovered many birds and animals new to science. His vast collections of over 60,000 specimens include the world's largest assemblage of the birds of Mexico. He is the Director of the Zoological Laboratory at Occidental College, Los Angeles, and has recently presented his collections to this college. For four years he was Chairman of the Galapagos Committee and was instrumental in having a large part of this Archipelago set aside as a sanctuary for zoological life. Dr. Moore is the author of over 70 articles on zoology, breeding, and exploration and is Chairman of the group of co-authors of The First Check List of the Birds of Mexico.—ED.



▲ Wood's Parrot (*Amazona finschi woodi* Moore) from a painting by Walter A. Weber. The scene shows Arroyo Hondo, where the bird was discovered by the expedition

"Yes. I don't like the way Juan says he 'knows' the trail. I'll bet a dollar to a doughnut he's never seen the Barranca and he's dependin' on some sweetheart up in the Tara country to show him the way. As for the others, they may desert anytime."

"Then you're afraid to try it?" I challenged.

"Oh, no, Bob," he exclaimed with calm fire in his gray eyes. "I'll go, but you're warned!"

So here we were, a year later, chugging up to Jim's ranch door at eight in the evening, after crossing the plains from Navajoa and its glittering flame trees on as hot a day as a copper sun can create. Our party consisted of Jim, Paul Austin, Tommy Wright, our chief preparateur; Juan, five half-breed Indian *cargadores,* myself, fifteen burros, and five mules. It was on May 4 that our party clattered forth gaily on the "Caliente Trail," whose name should have warned us of the heat that was to come. The hoofbeats of our pack animals startled a large flock of Sonoran White-fronted Parrots from the feathery *sabinas* arching overhead, and they soared about in short half arcs, chattering continuously on the same note. We disregarded the heat, believing we soon would climb into a cooler region. Here, too, we saw our last flock of Magpie Jays and marveled at the grace of their cadet-blue tails, eighteen inches long, streaming across a brassy sky. Equally striking were the great Military Macaws, always in pairs, propelling themselves with powerful strokes at high altitude, while they talked to each other with raucous familiarity.

That afternoon we passed Colmoa on the Rio Fuerte and plunged into the stifling Limon Canyon, its cliffs covered with columnar *hecho* cacti and the rambling obese roots of huge wild fig trees. That night we tented at Palmar, where chachalacas filled the night with a counterpoint of harsh calls.

The next morning we passed a wooden cross stuck in a pile of rocks marking the spot where someone had been assassinated. Had we been superstitious, we might have forecast disaster, but still beauty stayed with us, defying the increasing heat. An enormous grove of *amapas* waved a golden salute; a Coppery-tailed Trogon streamed across our trail, his flashing belly blood-red in the fiery sun; and great white salvers of what Jim called "papache" flowers hung in areas of radiating fragrance. That noon we lunched at a vile-smelling spring, whose filth had lured a group of pigs to wallow in it, and then our first enemy struck without warning. Paul, parched beyond endurance but heedless of our shouts of danger, fell prone and drank. Ironically, flaming cardinals were whistling and mockingbirds were singing as if to taunt our throats, which were too dry to sing or even talk. Descending a long exposed grade to the accompaniment of the cries of vulture-like hawks, the Caracaras, we hobbled into Descanso, Sinaloa, to find a spring of PURE water near a grove of *huamuchil* trees. Our swollen throats were soon lubricated. If only Paul had waited! That night he was seized with cramps and rolled in pain. I kneaded him throughout the anxious hours, while a screech owl, the Sinaloa Vinaceous,[2] quavered a tremulous obbligato. Dogs howled, mosquitoes bit, pigs snooped, and Indians stumbled about, drunk from the *Cinco de Mayo* celebration.

In the morning Paul, though obviously weak, insisted on continuing. Jim refused to vote, saying we would reach an altitude of 1600 feet at El Orito. When I asked him if it would be cooler, he shook his head. I made the difficult decision to go forward for at least one day more.

About ten in the morning we reached La Junta, the junction of the Chinipas and El Fuerte. Pushing our way through white flowering papaches as fragrant as gardenias, we entered the swirling Chinipas above the junction. The water rose to the backs of the wobbling mules, but we got through without disaster. Sheer cliffs faced us, but we reached El Orito at 1600 feet. The altitude proved no cooler, and we crawled under a low oak to lunch.

Now it was Tommy's turn to collapse. Refusing the canned crabs, which still tasted good to Jim and me, he plunged into the dirt under a desert shrub and paid no heed to questions of concern. His old enemy malaria had struck him down. I had not known he was subject to periodic recurrences. Two hours later he insisted on continuing, so we lifted him onto the most comfortable mule we had. For the next two days he hunched in the saddle like one in a trance. Philosophy was now our only comfort. Jim and I passed it back and forth in a desperate attempt to keep up courage. Crabs still tasted good to us, but sardines were anathema to all.

On the 7th, after leaving the oaks at 1800 feet altitude, a steep, torrid climb brought us to 2300 feet in an association of mountain mahogany, papaches, and white lantana. Our throats were now parched and swollen almost beyond endurance. During the lunch hour at Cresta del Cedros, Jim looked mournfully at a slimy pool of green water at the base of a cliff, forbade us to drink it, but suddenly succumbed himself. His years of prospecting must have made him immune, for he suffered no ill effects. But the situation was getting serious. I reached into my personal bag and took out one of the cans of grapefruit juice I had reserved for this purpose. No nectar of the gods could have tasted more delectable. My other ones must be kept for the hot days ahead and the return trip through this inferno. Paul and Tom were now in a bad

▲ A NATIVE FAMILY of Tarahumares in the Vasagota Valley

◀ FROM THE CREST of the Sierra Madre Occidental at 7400 feet, the explorers looked down into the cuplike Vasagota Valley, completely rimmed by mountains way, and the heat had shaken the endurance of all. Tough old Jim maintained his cheerful attitude and sphinxlike smile. My notes that night were anything but cheerful: "Tom ill, Paul still in a bad way. We met Indians who say there are huge fires ahead! Mosquitoes and wandering burros, frightened by jaguars, make the night hellish!"

---

[2] *Otus asio sinaloensis.* After the expedition's return to the States, it was described by the author as new to science (Proceedings of the Biological Society of Washington, vol. 50, p. 64).

On the morning of the eighth, Jim called me aside and admitted he was worried about the condition of the mules. He feared they could not make the 3000-foot climb up the Cresta del Tigre in the terrific heat. Further, he said that the Indians we had met had reported that the fires, set by bee-hunting Indians, had burned up the grasslands beyond the Tigre, where he had hoped the pack animals could recuperate their strength. We must buy corn as soon as possible. We decided to risk the Tigre and hope to get corn from Indians at villages above it.

El Tigre proved true to its name. Its claws were sharp rocks on the slopes of hairpin turns, which ripped our bags and unseated the loads. Halts became more frequent for adjustments, and all the pack animals were breathing heavily in the murky heat. Sweat rolled down our bodies. We were stripped to shorts. We made the top at the 4000-foot altitude and found Encino Gordo nothing but a huge fallen oak by the road and one hut on the mountainside. The occupant would not sell his corn! Our duffel bags were cut in several places and had to be repaired. They would not stand much more.

That night jaguars frightened the pack animals. As I planned for the morrow, I watched the burros hovering close to our sleeping bags, their patient faces bespeaking ages of endurance of hardships, amid cruel sunlight and dangerous darkness. Little sleep for the leader! But the predawn brought one of the loveliest songs I had ever heard, rivaling the Fox Sparrow's of the Magdalen Islands in the Gulf of St. Lawrence. It began with three rapid high-pitched notes on the same tone, followed by a dashing series, zigzagging up and down the scale, and ending with an exquisite trill of rich overtones. I guessed it to belong to McLeod's Sparrow, which I had never heard.

On this morning of the ninth, an Indian boy rushed up with news that the fires had crossed our trail ahead, burning several square miles and consuming the grass we were relying upon. At eleven o'clock we rounded a cliff and came in sight of the flames. It was a frightening prospect! The fire had cut our only possible trail, and a wind was driving the flames toward the great Cumbre de Lojito, which Juan claimed was a worse ascent than El Tigre.

Skirting the fire, we left the trail and drove our tired animals up steep rocky ridges. At last we dropped into a ravine and gulped down a hasty lunch under our first cottonwoods. Jim wanted to make

◀ Arroyo Hondo, viewed from beneath the cliff where the Stygian Owl awoke the author camp here for the night to rest the pack animals, as they would have no food above. I protested vigorously, pointing out that should the wind veer in our direction, we might be completely trapped by the flames. Fortunately Jim yielded, and we climbed a half mile higher up the ridges to a small field and hut, known as "Portreros." While we watched, the wind did change and the fire swept that ravine. Jim, Tom, and two Indians who had crept down to bathe in the pools barely escaped being asphyxiated. Our pack animals were exhausted, but they were munching the little grass available, and I reluctantly gave orders to camp.

We watched the wind drive the flames up the front of our mountain eyrie, while a thunderstorm without a drop of rain passed over our heads. Slowly the fire mounted the rocky slope. Less than an eighth of a mile away, the wind died down and the flames, having little but rocks to feed on, sputtered out. But the fire continued to burn below. By changing sentinels every hour, we tried to snatch a few moments of sleep before dawn.

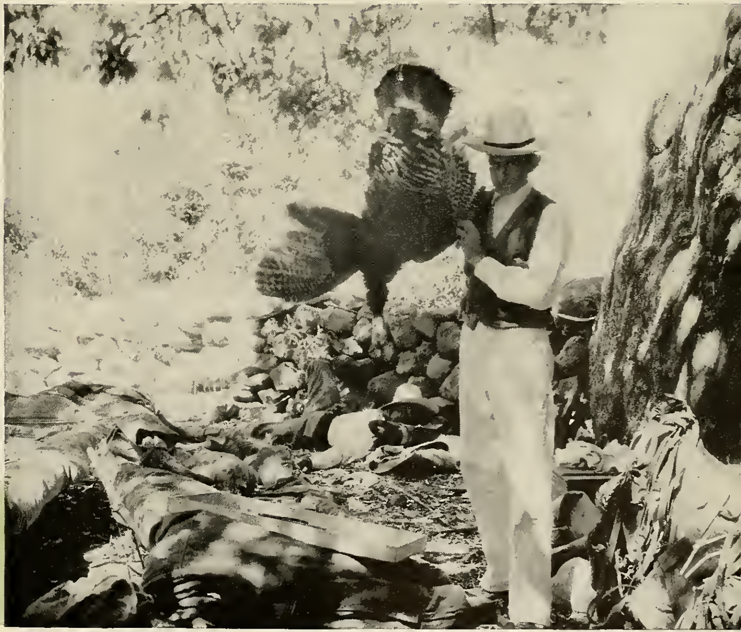
On the tenth the Cumbre de Lojito proved to be everything the Indians claimed, a frightful climb of 3500 feet. Exceedingly tortuous and steep, it displayed an endless number of hairpin curves and a trail that was nothing but a bed of rocks. For a while it seemed the mules could not possibly make it, although the burros managed better. Every 200 or 300 yards the loads slipped and had to be rearranged. All the animals breathed heavily, frequently stopping and refusing to climb higher. The Indians were nimble as jack rabbits whenever a burro jumped the trail to try to turn and descend.

At a point nearly 6000 feet in altitude we paused and were amazed at the tremendous panorama of the entire route we had covered during the past seven days. All of southern Sonora lay at our feet, and Jim pointed out two peaks that he said were near his Guirocoba Ranch. We were among pines and oaks in the Transition Zone. We had much to be thankful for. It was cooler now, and for the first time in three days Paul and Tommy seemed more lively. Zestfully we threw ourselves prone beside mountain streams of pure water that dashed across the trail. Flower and bird life had almost completely changed; the beautiful red-barked madroño had become common.

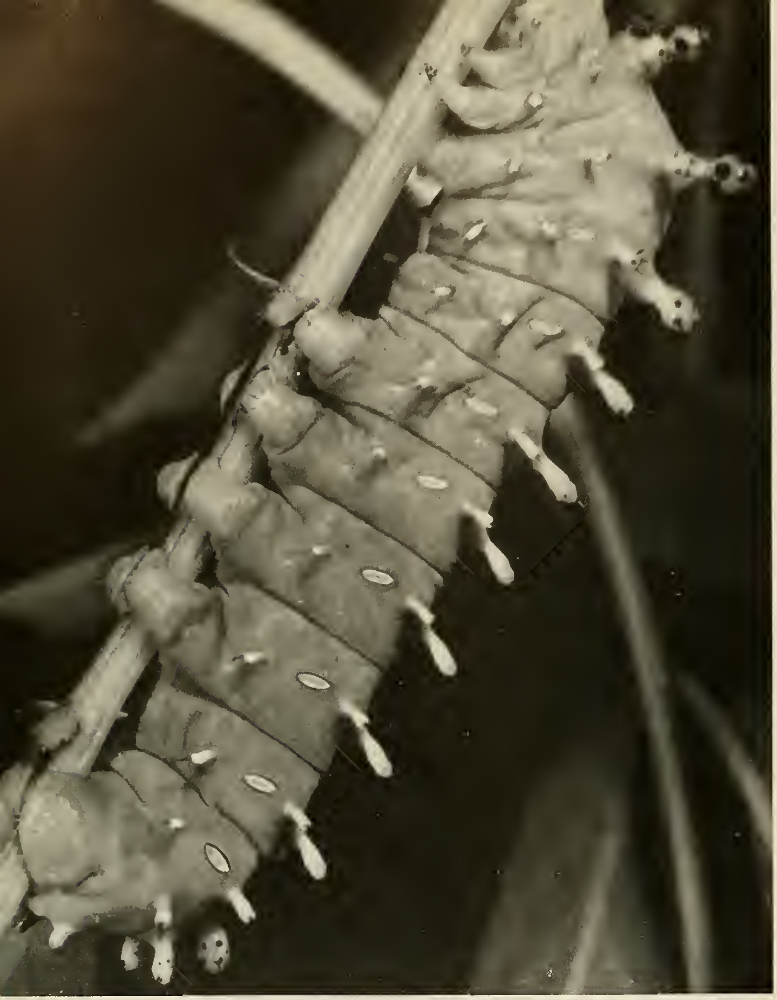
Two hours later we reached the top of the climb at 7400 feet. Behind us curled the snaky trail of our ascent; on the other side, 1000 feet below, lay a cuplike valley completely surrounded by a mountain rim. Down the two-mile floor cascaded a wild torrent through a patch of farmland which was being worked in community by a group of Tarahumares who called their valley Vasagota. But the greatest surprise was acres of wild grass for our starved mules and burros! We immediately decided to camp for two nights to give the animals and *cargadores* a well-deserved rest. Meanwhile we would collect zoological specimens. Our first attempt was a combined hunt for a giant bat coursing at great speed over our tents. At length Tom dropped it, crying, "I've never seen anything like it!" But the most interesting sounds to me were unmistakable gobbling on the mountain walls. During the night I heard these turkeys from four different points on the rim. Hunters had reported them to be extremely large and black, but no specimen had reached the museums.

On the eleventh, Paul and I hunted turkeys from the predawn until darkness, when a rain-bombing thunderstorm forced us to find our way back through an inky night to the tents. I saw none, but Tom had encountered five without securing one. I collected several specimens of the Chihuahua Grosbeak, however, of which only one individual had ever been taken before. Hummingbirds and warblers of several species were common, and I observed two Thick-billed Parrots at close range, apparently the first record of their occurrence on the western side of the Sierra Madre.

Continued on page 473



➤ JIM MCCARTY and the turkey new to science that the author secured at Guayachi



The camera
brings us closer
than we ordinarily get
to one of the wonderful
transformations in
the insect world

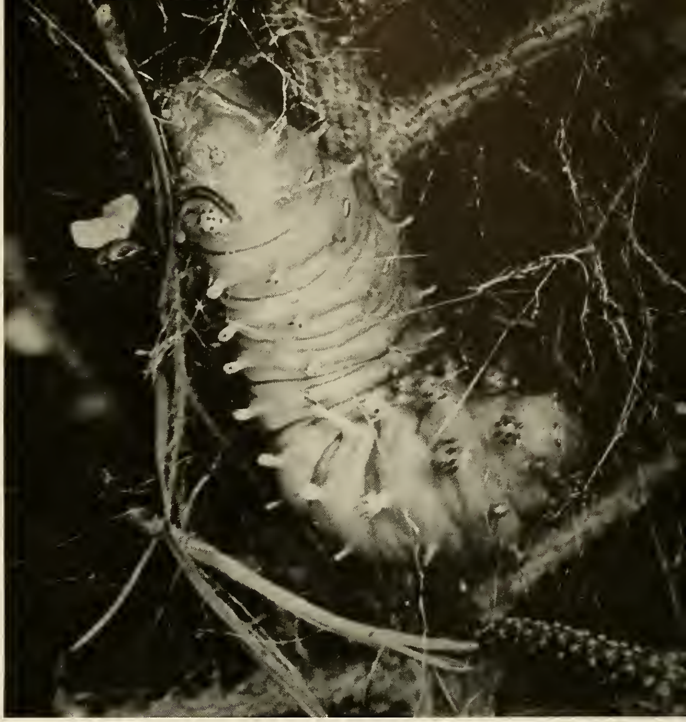
By
LYNWOOD M. CHACE

▲ THIS CLOSE-UP shows how the oddly fashioned legs of the Cecropia caterpillar grasp onto a twig. The creature can cling to a branch so tightly that it is sometimes difficult to pry it loose

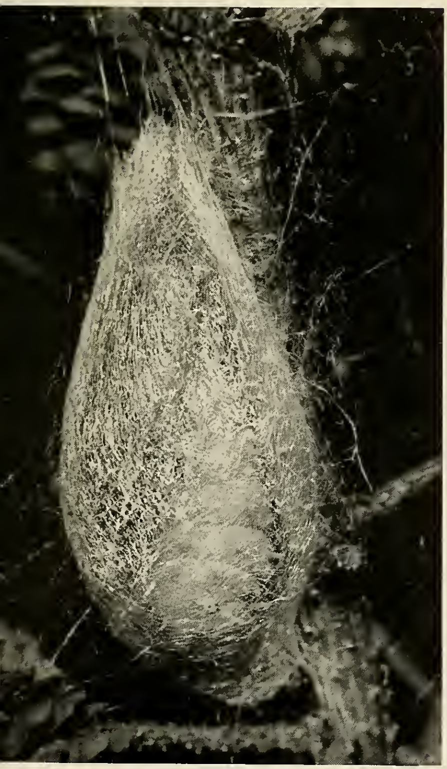
A Cecropia Moth Emerges

< **Every so often** the caterpillar of the Cecropia moth sheds its skin. Here is the discarded skin in a wrinkled condition

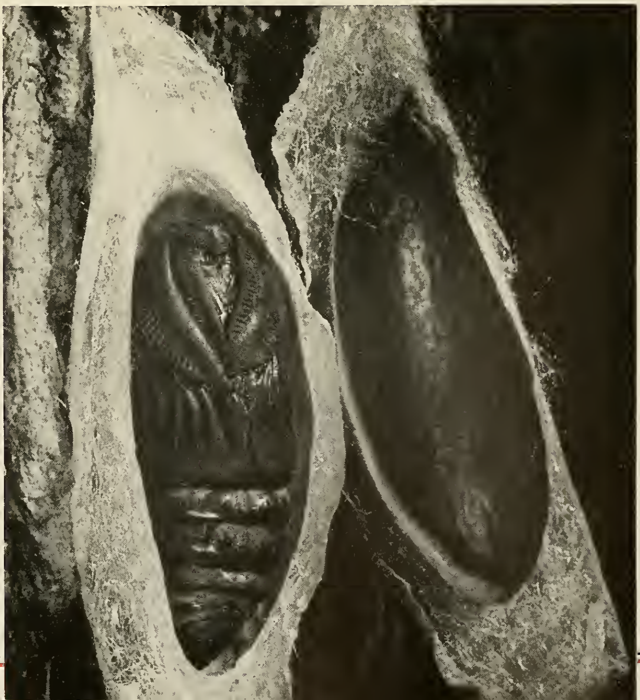
> **When the caterpillar** reaches a certain stage, it begins to spin a cocoon for itself, producing the silk substance from its mouth. The caterpillar slowly waves its head back and forth, attaching the silk strands to objects to form the cocoon

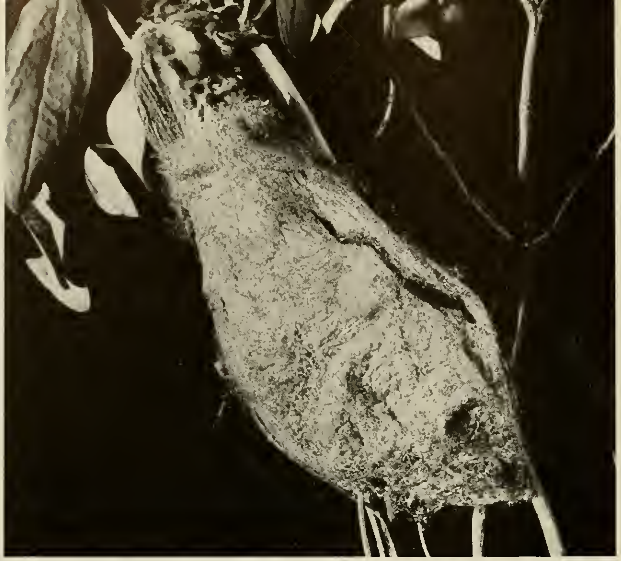


∨ **Here the cocoon** is almost completed. Its walls are still thin, and you can see the caterpillar within. The insect is now hard at work constructing the interior of the cocoon



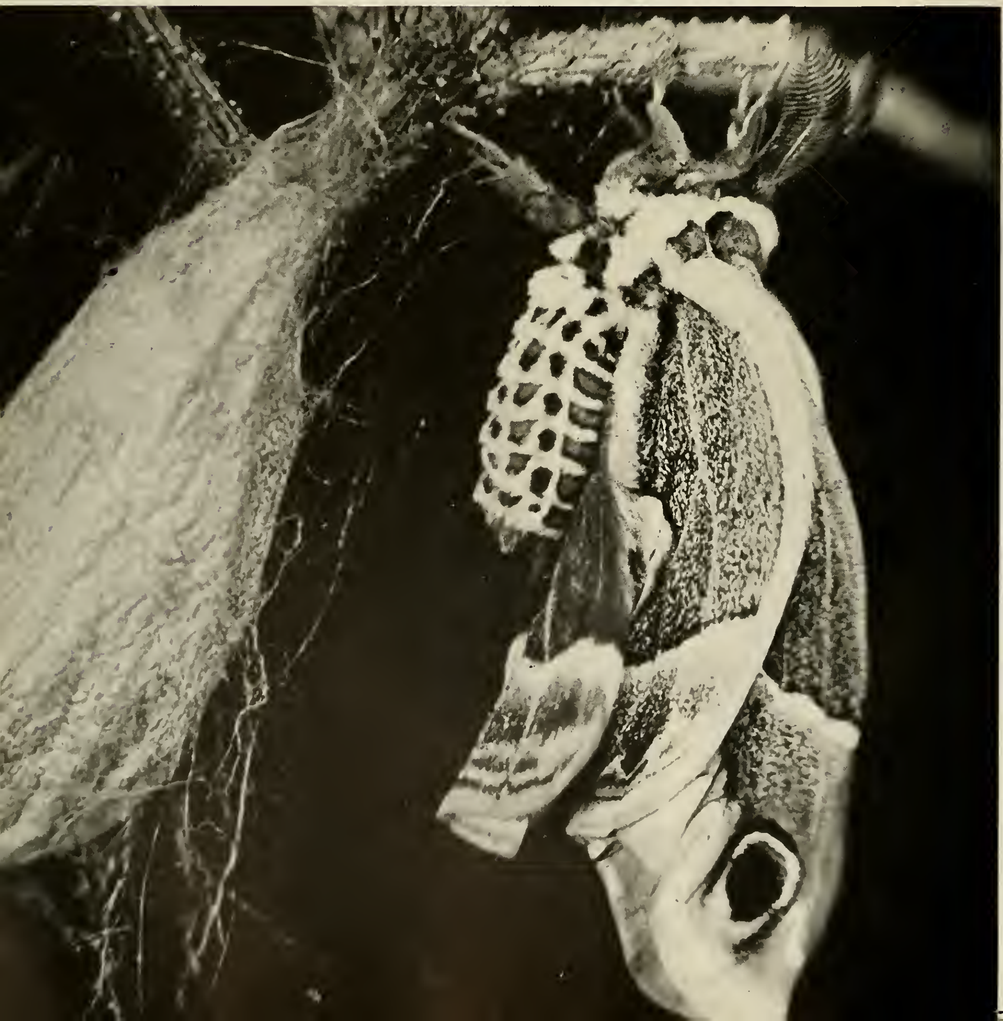
∨ **Having completed** the cocoon, the Cecropia caterpillar sheds its caterpillar skin and goes into the pupa stage. Here the cocoon is cut open to expose the odd-shaped pupa. The cocoon is carefully constructed with an outer silk layer and an inner one of silk packing. Thus the pupa is protected from freezing in cold weather. The moth does not hatch until the following spring

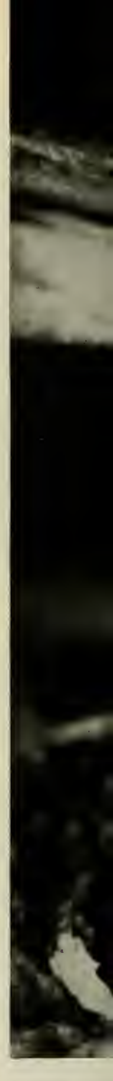


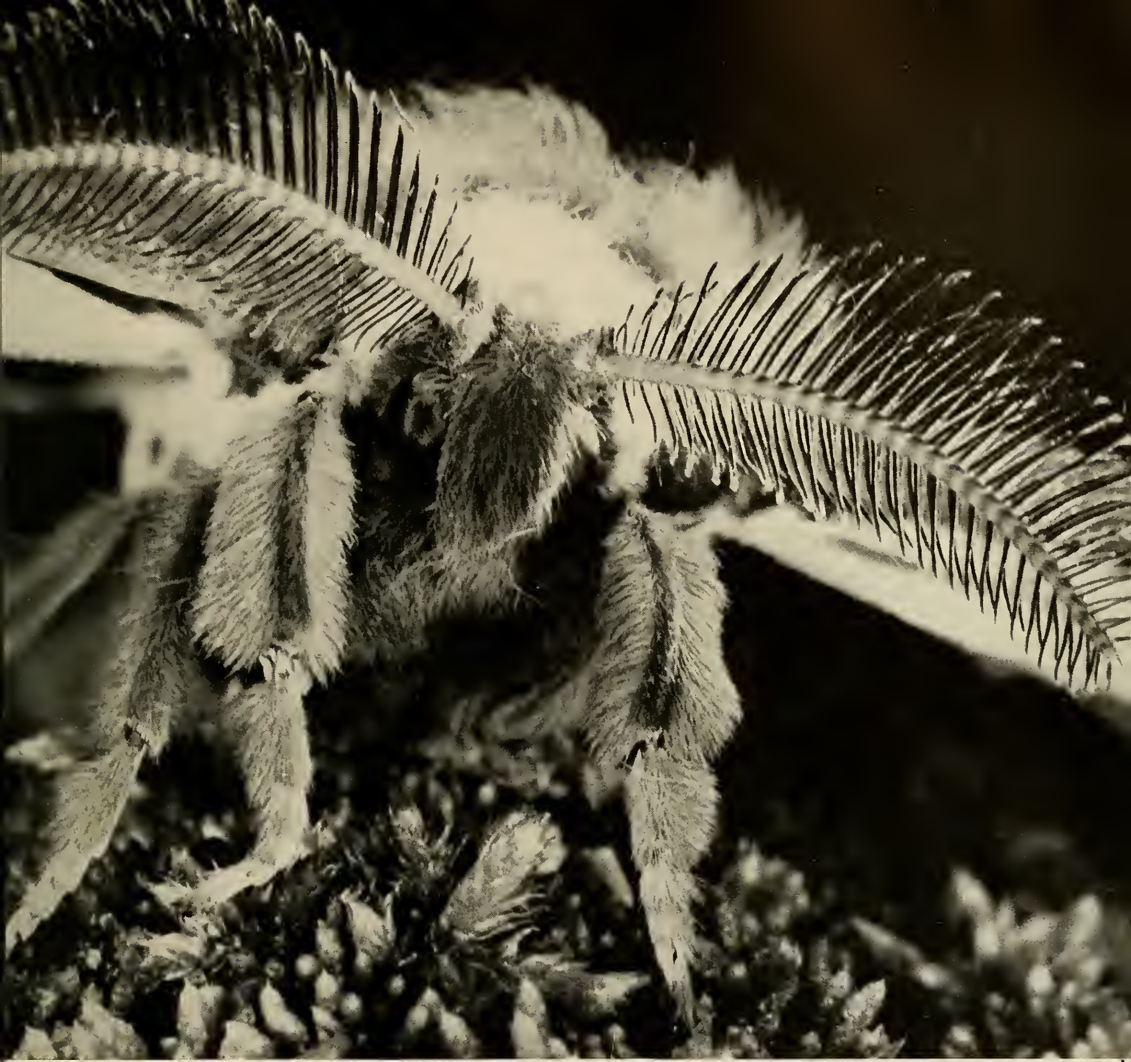


< WHEN the weather gets warm the following spring, the moth emerges from the cocoon to renew the cycle enacted by its parents

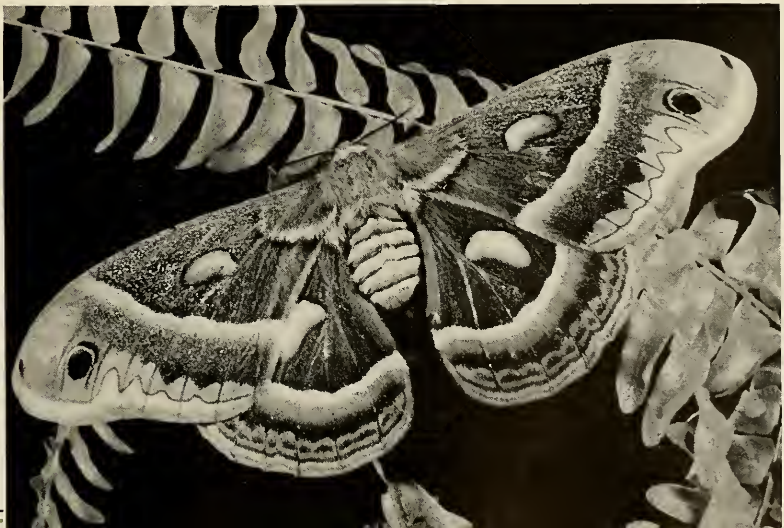
▾ WHEN THE MOTH first crawls out of the cocoon, its wings are soft and very fragile. It clings to a twig until its wings are fully developed. This is a male Cecropia







Viewed at close range, the ernlike antennae of the male Cecropia and its shaggy "face" give it a fantastic appearance. But most of us see the insect t a greater distance — as a andsomely patterned creature of the air

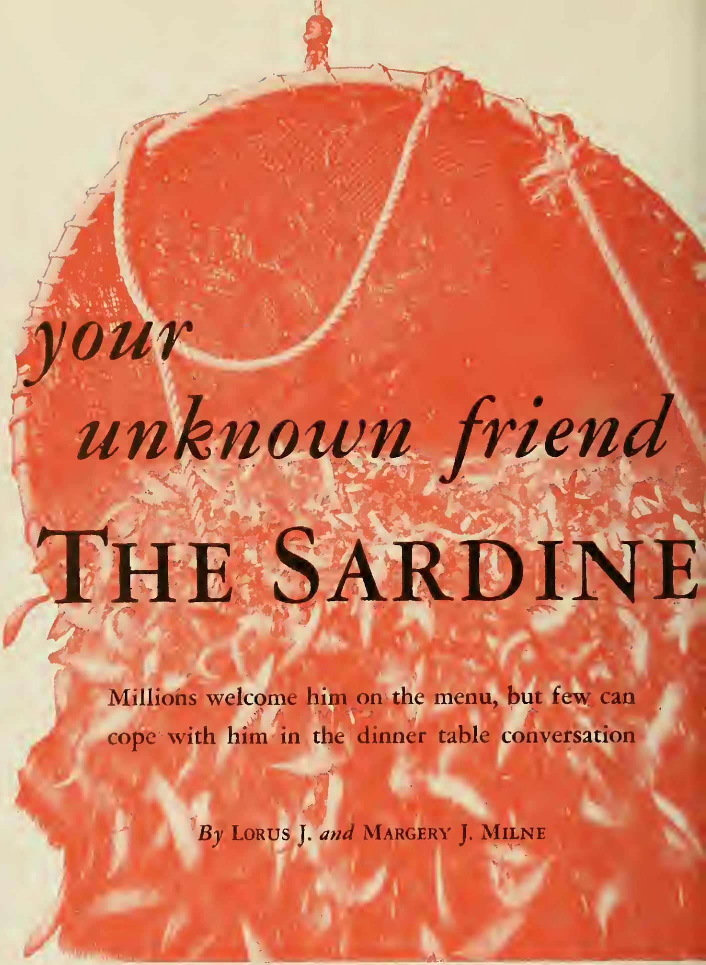


➤ The female moth, which emerged from a near-by cocoon, is likewise a beautiful creature. Its wings, now fully spread, display a lovely pattern

your unknown friend THE SARDINE

Millions welcome him on the menu, but few can cope with him in the dinner table conversation

By LORUS J. *and* MARGERY J. MILNE



Philip Gendreau p

Acme photo

HOMEWARD BOUND: well loaded with sardines, the purse seiner leaves the fishing area and heads for port

WE were on familiar terms with sardines laid neck to tail in olive oil, but it took a whale to introduce us to a live sardine. We knew the sardine in mustard, in chili sauce, and in just plain "oil"—all neatly packed in a can with a key, but the living fish, complete with head, insides, and particularly scales, in its home at sea—that was completely beyond our experience. So were whales, in spite of Frank T. Bullen and Herman Melville. But our introduction occurred on board a little fishing boat off the Maine coast near Ogunquit, on a course that led to lobster traps.

When a Maine fisherman, minding his own business, sees a whale surface and spout a few hundred yards from his boat, he doesn't shout, "Thar she blows!" He doesn't even yell. But he may remark drily, as one did to us: "Must be sardines yonder." For whales are a major peril to small fish, and sardines (before canning) live in schools that number upward from three billion individuals to populations of nobody knows how many.

The finback whale that made the introductions occasioned us so much excitement that we almost missed the skipper's casual comment. Sardines had no space in our minds while a live whale, our first, was humping its huge back into sight as though riding the curve of an enormous barrel rotating slowly below the surface. The blackish mound would rise into view, only a foot or two out of the water but as broad as our boat. The blowhole would open and a cloud of vapor push up 20 feet into the air like a miniature of Old Faithful. Then the smooth movement of the forward roll would take the head below while a tremendous back heaved over, its progress marked by a small triangular fin. But the back was as long as our 40-foot boat, and it slid from sight without a visible flip of the transverse tail behind it.

No doubt sardines by the million were rushing at top speed away from the whale. Our skipper pointed to the water just beyond our boat, and while no fish were visible, the whole surface was roiled by the movements of the swimming just below. Why they remained so close to the surface when a concerted dive might have eluded the whale, we could not guess. But the monster mammal plowed through the frantic fish, and it was easy to reconstruct what happened each time the cavernous mouth opened and closed. As the gape appeared, water and fish rushed in, but when it closed again, only water emerged. The sardines were tangled among the hundreds of hair-fringed whalebone plates hanging like thin flexible stalactites from the roof of the animal's mouth. And when the lips met once more, a great bulbous tongue rose from the floor—partly by muscular action, partly by inflow of blood into tissue spaces within—and squeezed the sardines out of their nooks and crannies, down the whale's throat.

The herring gulls above were no more concerned about the whale than were the Maine fishermen. Far from the cetacean or close to it, they recognized the turbulent water stirred by the sardine schools. In plunged the birds, to rise with fish in their beaks, to swallow them while air-borne, then to dive again for other victims, until their crops were full. This was their method of catching herring—for the Atlantic sardine along the Maine coast is *Clupea harengus*, whether food for whale or bird or man.

Almost everything in and over the sea, as soon as it is bigger than a herring, begins to eat these fish. And since herring come in so many different sizes, perhaps no one kind of backboned creature is more preyed upon by its neighbors. The bluefish and the tuna, the whitefish and the cod, the dogfish and the haddock, hake, pollock, and squid, all devour countless numbers. Seals and porpoises fatten at the expense of herring. For man "the herring is beyond question the most important of food fishes in the Atlantic, if not in the world." Small wonder, then, that the life span of a herring cannot be stated in years. Of 30,000 eggs laid annually by each mature female herring, an average of less than 2 survive to repeat the cycle. On the precision of this average rests the rise and fall of sardine populations in the sea. And on the 29,998 or 29,999 that are lost each year from each pair of Atlantic herring, numberless creatures depend for their own survival.

To survive so many successful attacks by enemies, sardines themselves must find plentiful food. Each of them is equipped with a sort of sieve in the gill region, which effectively strains out food particles from the water. The particles are microscopic algae and other minute plants in the upper levels of the sea (where sun energy can penetrate), plus the hordes of barely visible crustacea and various animalculae. Collectively these are known as plankton, and the sardine is a plankton feeder. Of all the small creatures on which herring thrive, almost the only one to have a common name is a tiny crustacean belonging to the genus *Euphausia*. It is known to fishermen as "red seed," because it becomes so abundant as to color patches of the sea. Sardines take both the algal plankton on which these crustaceans feed and the crustaceans themselves. Finback whales are equipped to filter from the same water both the "red seed" and the sardines that prey upon them.

Since no animal is more than ten per cent efficient in its use of food, a ton of sardines represents at least ten tons of "red seed" or similar food. And the "red seed" require at least ten times their own weight in algal plankton—hence a ton of sardines in this simple food chain rests on a minimum of a hundred tons of microscopic plants. A ton of whale represents further inefficiency and demonstrates how incredibly abundant are the living green "pastures of the sea," which supply the needs of "red seed" and sardines and whales and keep ahead enough to reproduce themselves as well. Man tends to overlook the immense quantities involved, but herring keep browsing until death overtakes each fish. Not that the huge population is wiped out at any one age. Some reach a length of eighteen inches—as multiple grandparents of more little sardines. Such a giant herring may be twenty years old,

R. Gates photo from Frederic Lewis

Nets filled with the sardine catch are emptied into a small boat, which will transfer them to the fishing fleet. In New Brunswick waters while those a gull or man prefers—five inches or less in length—have not yet reached their first birthday. Most of each 30,000 never live that long. But a ten-inch herring has reached reproductive age and is usually about three years old.

The eggs of the Atlantic herring are heavy; they stick together and sink to the bottom. The most valuable sardines of international trade, however, start out in no such fashion. They are the French sardines—luxury tidbits that gave the common name to the whole group of little fish, because Sardinia, in Mediterranean waters, was where this delicacy abounded. And a French sardine comes from a buoyant, floating egg—one of 60,000 each mature female lays through the summer. Properly these fish are *Clupea pilchardus,* and if not caught as yearlings to be canned in the familiar manner, head to tail, they may attain a length comparable to that of the Atlantic herring. In Norway there are two kinds. The Grade A sardines are known as *brisling* and are *Clupea sprattus.* The others are called *sild* and are *Clupea harengus.*

The word "sardine" has fallen into confusion. As popularized, the term has come to refer to any small fish that can be canned. To a Californian the word signifies what he calls a pilchard, *Sardinops coerulea,* caught at a size where two cleaned fish may fill a fifteen-ounce can. Such pilchards are caught in purse seines to an annual total of between 250,000 and 500,000 tons, and their market value amounts to at least 19 million dollars. Such fishing methods miss the small individuals and commonly take fish after they have reproduced at least once. Maine sardines, sought close to shore in smaller sizes, are all immature fish. Four to a dozen of them go into a 3½-ounce can; and those that are marketed annually in this way total only slightly over 40,000 tons, but they have a market value about equal to the total output of the California "sardine" industry. With the exception of cod, haddock, menhaden, and rosefish (redfish), more weight finds its way to the fish markets from the herring family than from any other source. Only salmon and tuna exceed the sardine and herring fisheries in value.

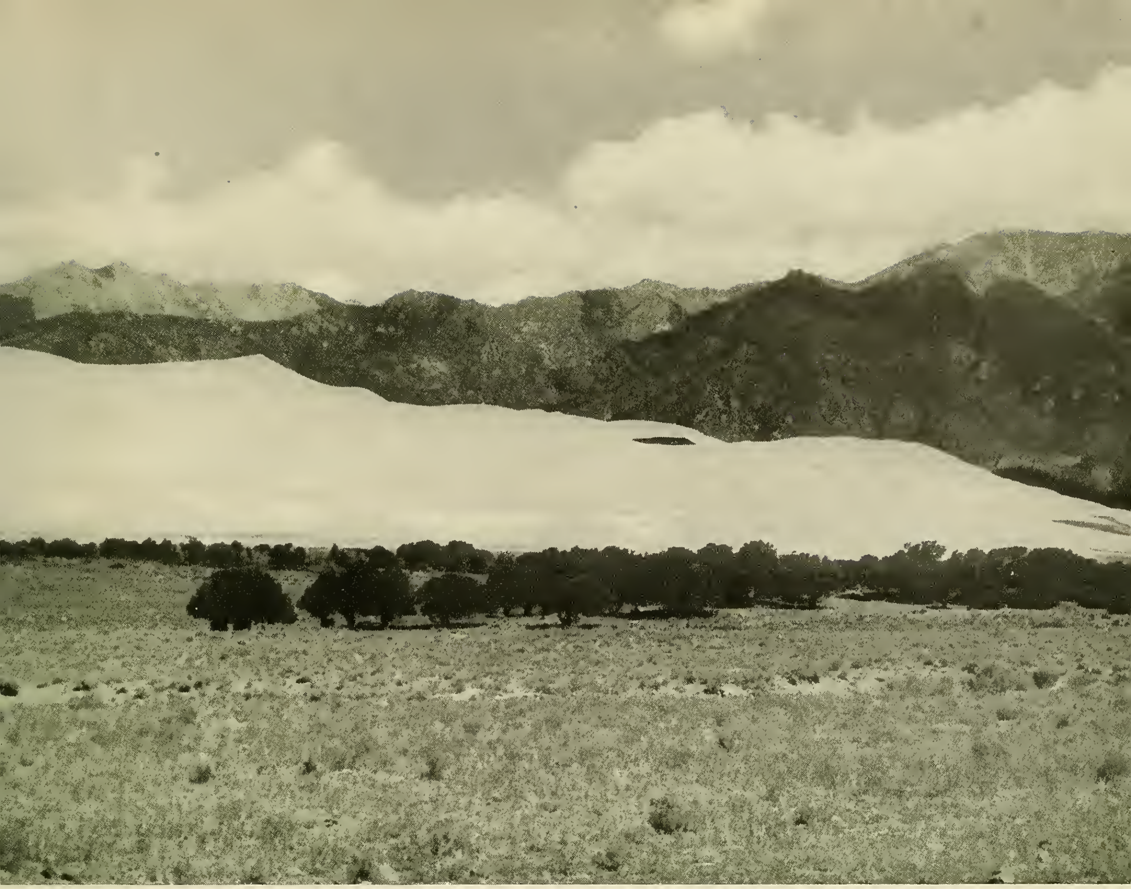
Atlantic sardine fishermen usually seek out regions where the fish breed in large numbers and then trap the young as they roam in schools. With so many mouths in a single group, there must be a tremendous demand for food, and sardines are apparently very sensitive to the taste of nourishment diffusing through the water. They will swim toward bait made of the salted roes of cod and other fishes, and they may be induced ("toled" is the word) into traps built of branches driven into mud flats. These are "brush weirs" such as are used extensively in the region around Eastport, Maine, at the Canadian boundary—the center of sardine catching and processing for the Atlantic coast. In a sense, a brush weir is a net made of interwoven plant materials, but the important feature is that it extends into the bottom, and through that bottom the fish cannot escape. In deeper water, a similar enclosure may be achieved through use of a pound net, whose sides are continuous with the bottom. The name refers to the impounding of the catch. Pound nets for sardines are often supported by a circle of floats, and the mesh is fine enough to limit the catch to useful sizes.

Wherever sardines are held captive, the surface of the sea takes on a curious, glittering appearance from countless minute scales. These fish have a poorer hold on their overlapping armament than most, and the mere brushing of one agitated animal against another serves to scrape loose the light-reflecting, tough transparent flakes. Often the scales, like sequins on a dark sea, are clues along the Maine coast to the arrival of a sardine boat—a floating factory more bulky than a finback whale and more destructive to the fish. Sardine boats can be anchored wherever sardines are abundant. Each boat is ordinarily equipped with a special boom from which a funnel-shaped net can be lowered into a passing school of herring. A huge pump on board then inhales a continuous stream of water from the funnel through a six- or eight-inch hose and sucks in sardine and sea together. Both emerge into a pound net on the opposite side of the vessel, the fish to be dipped out and processed at leisure.

Right on board, the fish are finally cleaned and sorted for size. Sea water rinses away the loose particles before the sardines are raised from the tanks on screens to drain. When almost dry, the fish and screens in vertical layers may be lowered into boiling cauldrons of oil—olive oil for high-grade small fish, cottonseed or peanut oil for poorer quality—and when cooked enough they are raised again to drip. Packing in cans requires hand labor, but the work proceeds with amazing speed. The waste parts, meanwhile, are dried as fish meal or manure. The canned fish go to the sardine boat's hold, while bags of fish meal are piled on deck. When sardines are running, several families may live on a single boat for weeks at a time, lending hands for the work and amassing a valuable cargo.

A sardine boat in American waters offers few of the niceties characteristic of the European sardine industry. There the gill nets are dyed blue, supposedly to conceal their meshes from the fish, though also to preserve the fibers. The season must be right for a French sardine to have the proper flavor, and cooking them becomes an art to save the savor and maintain the texture of the meat.

Likewise, the herring along the New England coast can only claim membership in this class of delicacy when quite small. Thereafter, if they escape to live to larger size, they come to the market fresh or dry as "red herring" or slightly salted and smoked as "kippered herring" or "snacks." When larger still, and strongly salted and smoked to cure the meat, *Clupea* becomes a "bloater." Thus modes and methods differ around the world, as do the fish that bear the general name "sardine."



▲ IN THE GLARE of noon the dunes look like a phantom range of snow against the timbered foothills of the Sangre de Cristo

THE Naked Hills

A migrating desert that is urged slowly ever eastward by the force of the winds

By ROBERT M. ORMES

Photos by H. L. Standley

THE dune areas are museums of modern art. Their hills, modeled from pure sand by the wind, have the mysterious quality of abstractions. With none of the customary clothing of plant life and only the slight variations in color provided by light and shadow, they seem too stark for reality. Nowhere in the vast museum of surface geology are the forms so simple and repetitive and yet so endlessly absorbing.

One of the most curious of these areas is the Great Sand Dunes National Monument. Its sands, collected from the shore of a long-forgotten inland sea, now form a baby four-by-ten mile desert in the heart of the Colorado uplands. Their floor is the San Luis Valley, a large flatland 8000 feet above sea level, where crops of potatoes, lettuce, and peas are raised. The valley itself would be a semidesert but for the plentiful supply of artesian water. It is cradled among hordes of peaks that run up to 13,000 and 14,000 feet.

Under the urge of the prevailing wind, the dunes have crept across the valley to its eastern edge. If the present migration continues, they will eventually pile up among the green-timbered foothills of the Sangre de Cristo Range. It requires no more than a moderate

breeze to keep the sand sifting its way upslope, and when the air is strong there is such a multitudinous tinkling of the grains that the whole dune seems to hum with life.

There are two distinct types of sand granules. One kind is a dull tan and nearly spherical. The other particles are smaller and more angular, and they have a wide variety of colors ranging from deep gray to pinks and blues. Assays from various parts have shown a modicum of flour-fine gold but not enough to make recovery worth while.

In the central part the dunes are well over 1000 feet high. In the clear atmosphere they can be seen from 50 miles away. They have brought comments from travelers ever since Zebulon Pike wrote about them in 1807. The numerous artifacts found in the

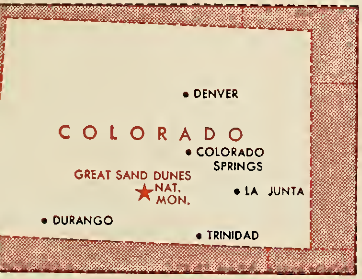
▲ THE DUNES move eastward in a series of slow cascades

▼ LONG SHADOWS are needed to show the work of the free-hand sculptures of the wind. The ripple marks are dunes in miniature

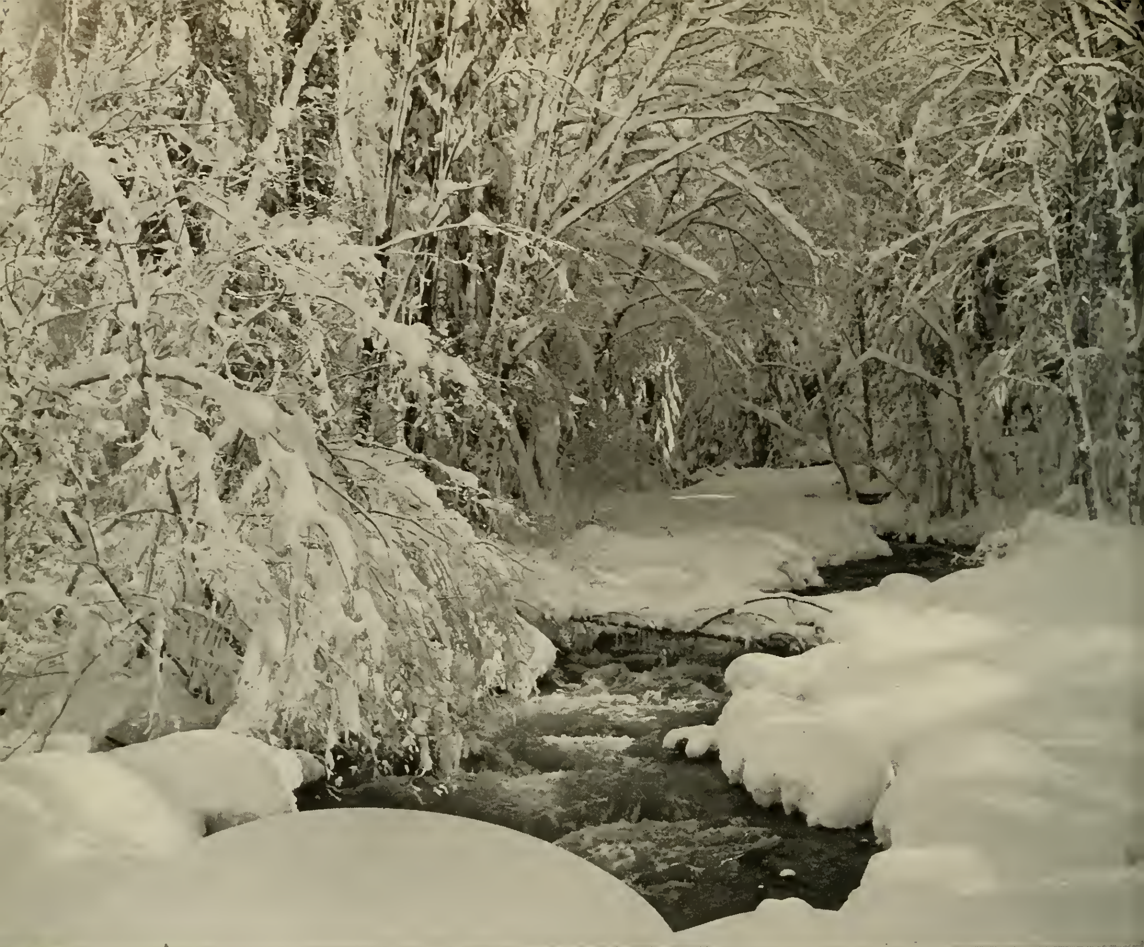
▲ **Nature, the sculptor,** shapes modernistic-looking mountains in duneland, and the lines are sharp but never straight

neighborhood indicate that the Indians, too, were attracted to this region.

Odd stories and legends persist about the dune country. One of them is about a troop of web-footed horses that are supposed to course over the sand as fast as if they were on hard ground, because their hooves are widened, overgrown versions of the normal. But we have not yet come by anyone who has seen these horses, and it seems dubious that they could make a living even from the sparse grasses of the periphery. Perhaps closer to the realm of possibility is the sheep story, which states that a shepherd and his whole flock disappeared among the dunes, and likewise the story of two teamsters whose wagon and hobbled mules were swallowed up by quicksand while they slept not far away. If there is any truth in these stories, it seems likelier that they can be explained by a visitation of bandits from Mosca Pass, which cuts through the Sangre de Cristo just west of the dunes and was for some time used as a wagon trail.



Skiers who visit the dunes can have an amusing time. In uphill work they avoid some of the strength-sapping influence of the sand, and with a hard wax they manage to get some good little downhill runs. But the real sport among the dunes is for the visitor who listens to their whispering and plays his eye over their rhythms and undulations.



▲ One of nature's innumerable crystal palaces in the Cascade Mountains of Oregon: a snowbound stream emerging momentarily to add the music of its waters to the muffled stillness

Winter through the Camera's Eye

By Ray Atkeson

WINTER storms sweeping in from the Pacific Ocean usually mean heavy snowfall in the higher elevations on the western side of the Cascade Range. Indeed, few areas in the world offer such an abundance of snow within a short distance of many large towns and cities. These photographs show several aspects of the fantastic winter fairyland that results.

Until recent years, residents of the Northwest were content to leave the snowbound wilderness in its natural state of loneliness. Now the situation is quite different. Modern highways, kept cleared of snow by giant rotary snowplows, have opened up the Northwest's winter wonderland to visitors bent on a variety of outdoor activities. All along the once snowbound crests of the Cascade Range there are numerous winter playgrounds. Some of the resort hotels nestle snugly in snow fields that are 20 to 25 feet deep.

Other persons keep a more serious eye on the work of the winter storm gods. Farmers watch the higher mountain peaks and pray for the deep snows that will ensure moisture for irrigation of crops in the valleys during the dry summer months. And forest officials hope for winter storage of moisture to hold in check the dread fires that sometimes cause such havoc.

The Northwest has finally come to appreciate the value of its snowy heritage.

➤ A SKIER'S DREAM of heaven comes true in the vast rolling foothills of Mt. Baker in Washington

▼ CHRISTMAS-TREE LAND: Mt. Hood rising sublimely beyond the spires of the evergreens

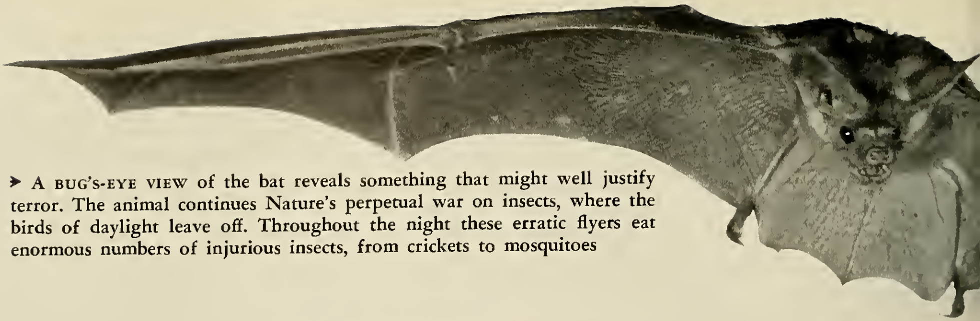
➤ Roaring through the forests and mountains day and night, a fleet of these giant rotary snowplows battle the element to keep the highway open to the very rim of Crater Lake

▼ Just below timber line on Mt. Hood is the Wyieast Club's Ski Hut, nestled in a protected glade in the heavy forest

▼ Bent not on recreation but on secu
ing vital information, a small group
hardy men pass the winter measuring an
estimating the moisture content of th
snow. Many occupations and ways of li
are affected directly and indirectly by the
reports. The Forest Service makes plans fo
controlling forest fires; farmers learn ho
much water they can expect for irrigation
and power plants foretell how carefull
they must husband their reservoirs
water for the production of electricity

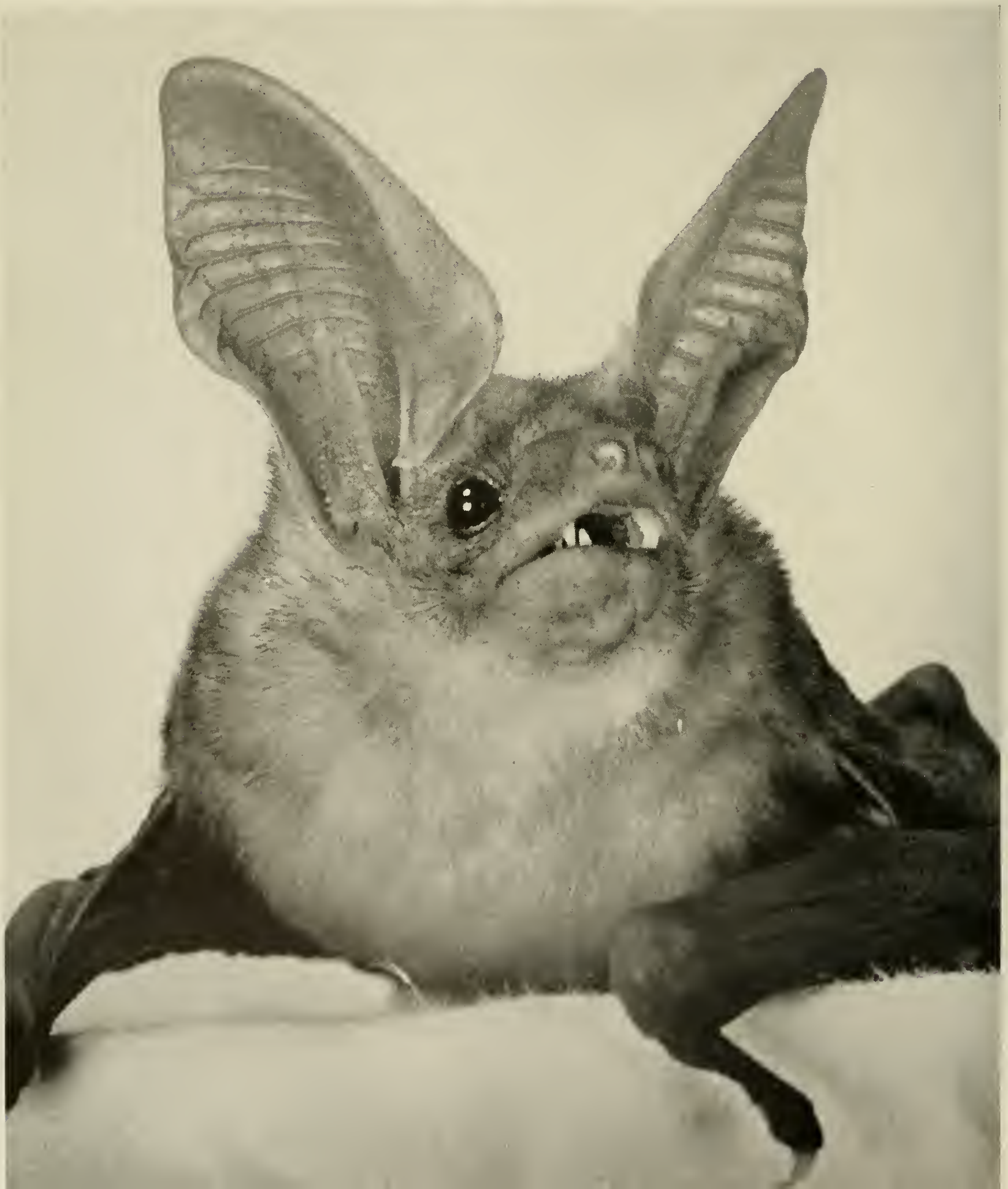
▲ **Mt. Baker**, lofty snow-mantled monarch of northern Washington, looks down on one of the most beautiful winter playgrounds on the North American continent

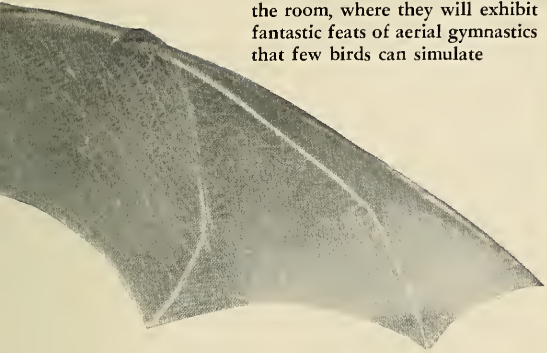
◀ **Wizard Island** seems to float like a snow-white jewel on the turquoise waters of Crater Lake

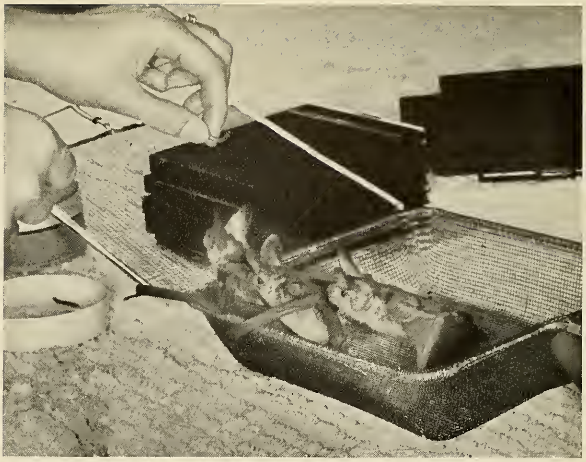


➤ A BUG'S-EYE VIEW of the bat reveals something that might well justify terror. The animal continues Nature's perpetual war on insects, where the birds of daylight leave off. Throughout the night these erratic flyers eat enormous numbers of injurious insects, from crickets to mosquitoes

⮟ PORTRAIT of a Pallid Bat







➤ BATS TRAIN easily to come to the hand for food. They can either be cage-fed or allowed to fly about the room, where they will exhibit fantastic feats of aerial gymnastics that few birds can simulate

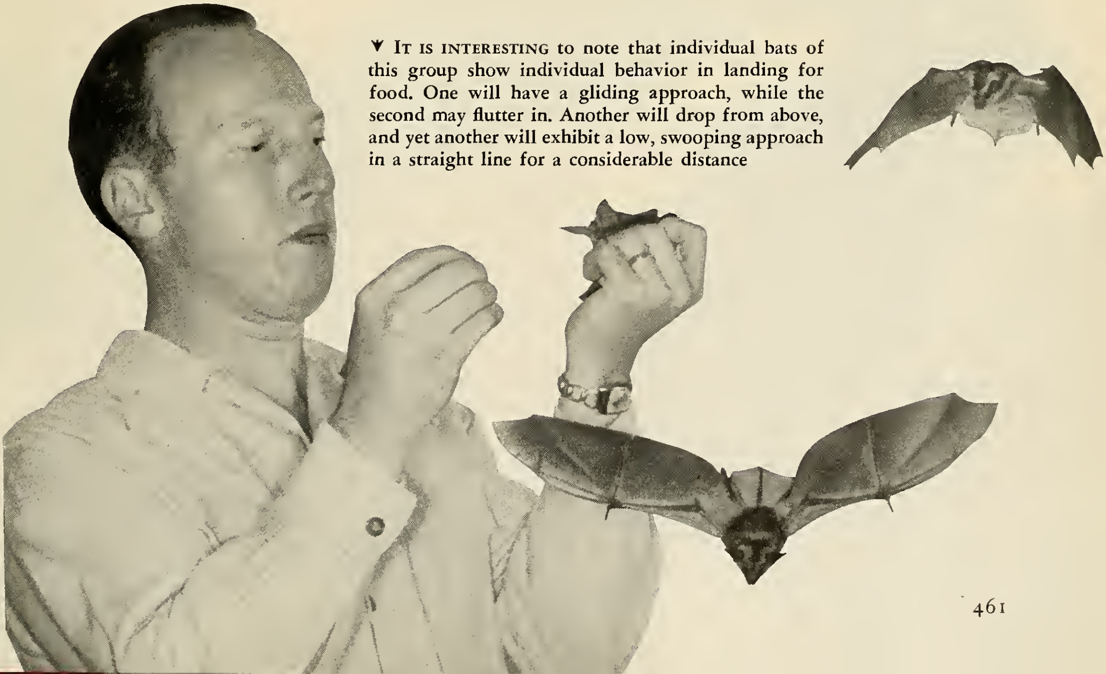
How Bats Fly

By Richard L. Cassell

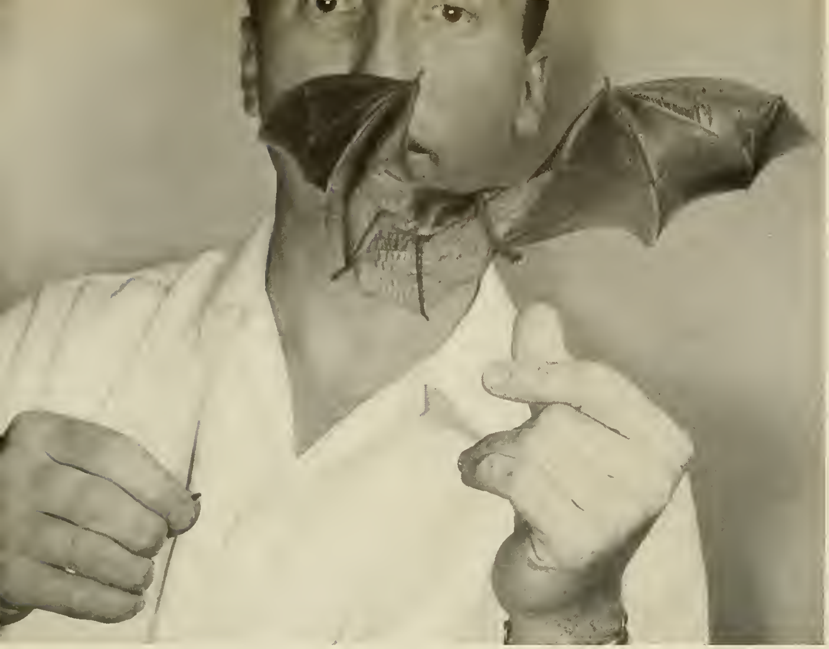
One of the most remarkable series of photographs to come from the super-speed camera shows how the only flying mammal maneuvers with consummate skill in a medium it has taken his two-legged cousins centuries to master

IN all nature probably no other creature is as shrouded in myth, superstition, and misinformation as is the bat. His weird appearance and choice of darkness readily make him an object of false conclusions.

In reality the bat is quite attractive. He will usually become tame in a few hours, showing evidence of affection and intelligence. He is clean, adapts himself to confinement, and soon proves himself not at all the Dracula of the movies or the sinister figure of fiction but a personable character, with traits commendable in any pet.



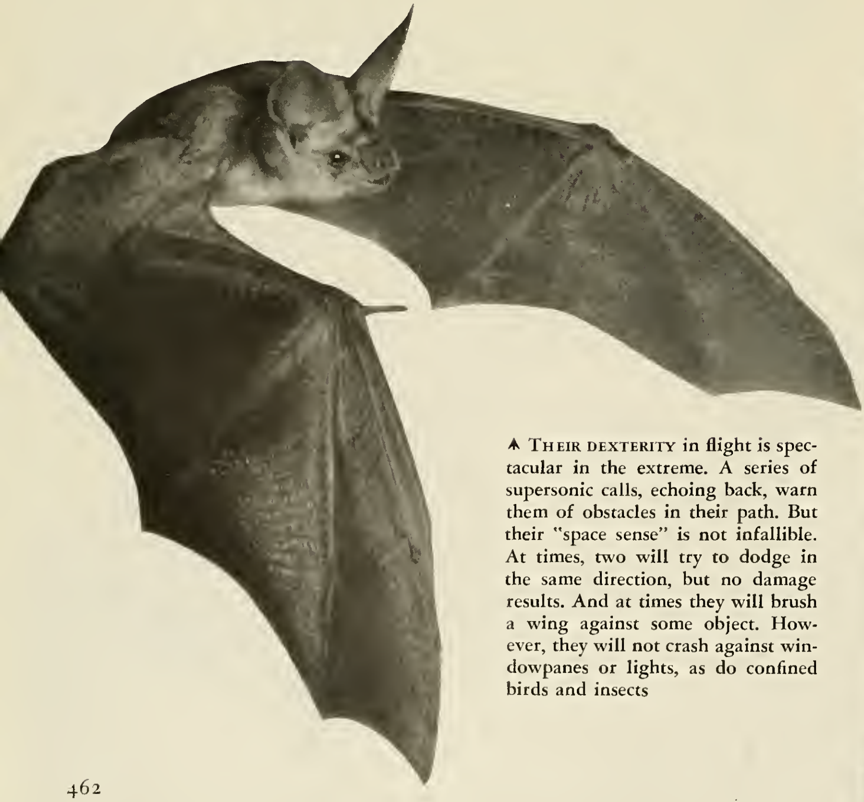
▼ IT IS INTERESTING to note that individual bats of this group show individual behavior in landing for food. One will have a gliding approach, while the second may flutter in. Another will drop from above, and yet another will exhibit a low, swooping approach in a straight line for a considerable distance



▲ SOUND, NOT SIGHT, seems to be the bat's principal means of perception in determining position, direction, size, and form. Here, the pet bat is guided to the hand for food by the snapping of the fingers. There need be no audible sound. The bat's extremely acute sense of hearing will bring immediate response from any part of the room

▲ GUIDED BY SOUND to the left hand, Flapper Fanny is handed a beetle larva. Mighty Joe hovers above

▼ MOST BATS are gregarious and will have a favorite resting place. In this particular instance, a picture hanging from the wall was the choice. Here, Mighty Joe "drags the field" before coming down

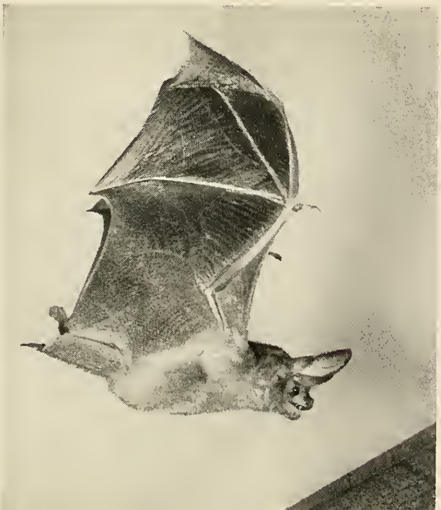


▲ THEIR DEXTERITY in flight is spectacular in the extreme. A series of supersonic calls, echoing back, warn them of obstacles in their path. But their "space sense" is not infallible. At times, two will try to dodge in the same direction, but no damage results. And at times they will brush a wing against some object. However, they will not crash against windowpanes or lights, as do confined birds and insects

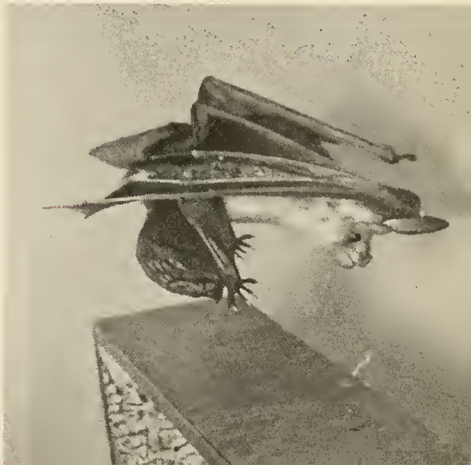
➤ **During feeding**, traffic jams are frequent and collisions imminent. Often one or more bats will remain clinging to the hands to gobble all the food and obstruct landing facilities for the others. But usually the tidbit will be snatched from the fingers, and flight resumed within a fraction of a second. The fingers may be chewed quite unintentionally in this maneuver, but such bites are infrequent and harmless

Thus modern photography proves that a creature man has disdained has long been the master of some of the finest tricks of aviation skill

▼ **Lining up** with the "runway" on the final approach, Flapper Fanny prepares to stall out



▼ **The "touchdown"** is accomplished by the split-second reduction of wing area. The skirt between the legs pockets the air and reduces forward velocity



An Orchid

of the CHAPARRAL

Its seed is as fine as dust, but the mature flower has a mechanism for pollination that is a marvel to all who have watched it in action

By Jerry Laudermilk

Drawings by the author

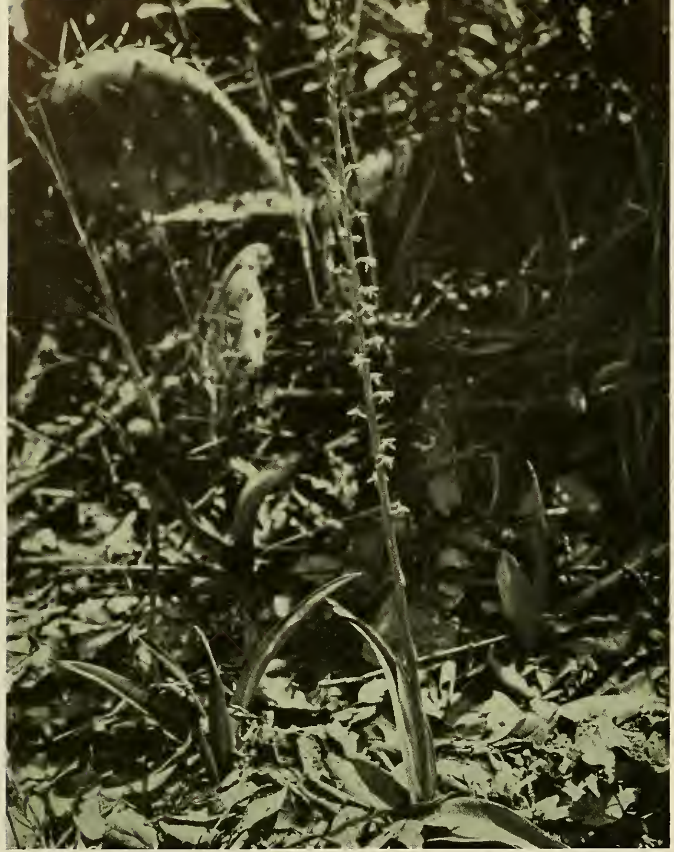


Photo by Helen Laudermilk

◄ The rein orchis, *Habenaria unalascensis,* which grows as far north as Unalaska, is here seen among prickly pear, squawbush, poison oak, and other plants of the dry chaparral. Photographed near Claremont, California

I WAS on the trail of an elusive orchid. Generally, when a yarn begins like this, it prefaces a jungle saga wherein the explorer staggers through mud, snakes, and mosquitoes in the wake of a treacherous native guide. But the locale and circumstances of this expedition were altogether different. The scene was a dusty stretch of chaparral inhabited by poison oak and devilish red ants that could outsting a wasp. My guide was a sinister and ponderously brilliant student who knew more botany than I and wouldn't laugh at my jokes. But to get on with my story . . .

According to this student – who swore he had collected orchids in the same territory the year before–we were "getting warm." This statement was true according to any of three different interpretations: geographically, physically, or temperamentally. In fact, I had just begun to associate the idea of the piece of clothesline around my plant press with that of the student's fat neck, when he made noises from his post at the head of our two-man safari, indicating that our objective had been attained.

When it came to locating a space about 15 feet square in the middle of 160 acres of chaparral, all of which looked alike, this student was a wonder. Here, on the desiccated slope, hobnobbing with a gang of colorful plant characters known as sotol, prickly pear, buckthorn, and sagebrush, stood about a dozen cool, self-assured individuals of the small, green-flowered rein orchis *Habenaria unalascensis,* which ranges all the way from Unalaska Island in the Aleutians to the south end of California.

Like practically all our native orchids–and about 150 species can be found inside the United States borders–this Habenaria is rare without being actually scarce. It has perfected a knack for keeping out of sight. The plant is green all over, its leaves wither by flowering time, and by early summer it is ready to close up shop for the season without having advertised its stand to any but the dozen or so nature-wise folks in the neighborhood.

Going by externals only, it takes a robust imagination for anybody not initiated into the secrets of plantdom to see any relationship between the unpretentious, greenish-white Habenaria flowers and those elegant, mauve or shell-pink "creations" that come out of hothouses. But if you look closely with a lens and poke about a bit with a needle, you will soon find that Habenaria's floral architecture holds all the credentials for membership in the illustrious clan of the Orchidaceae.

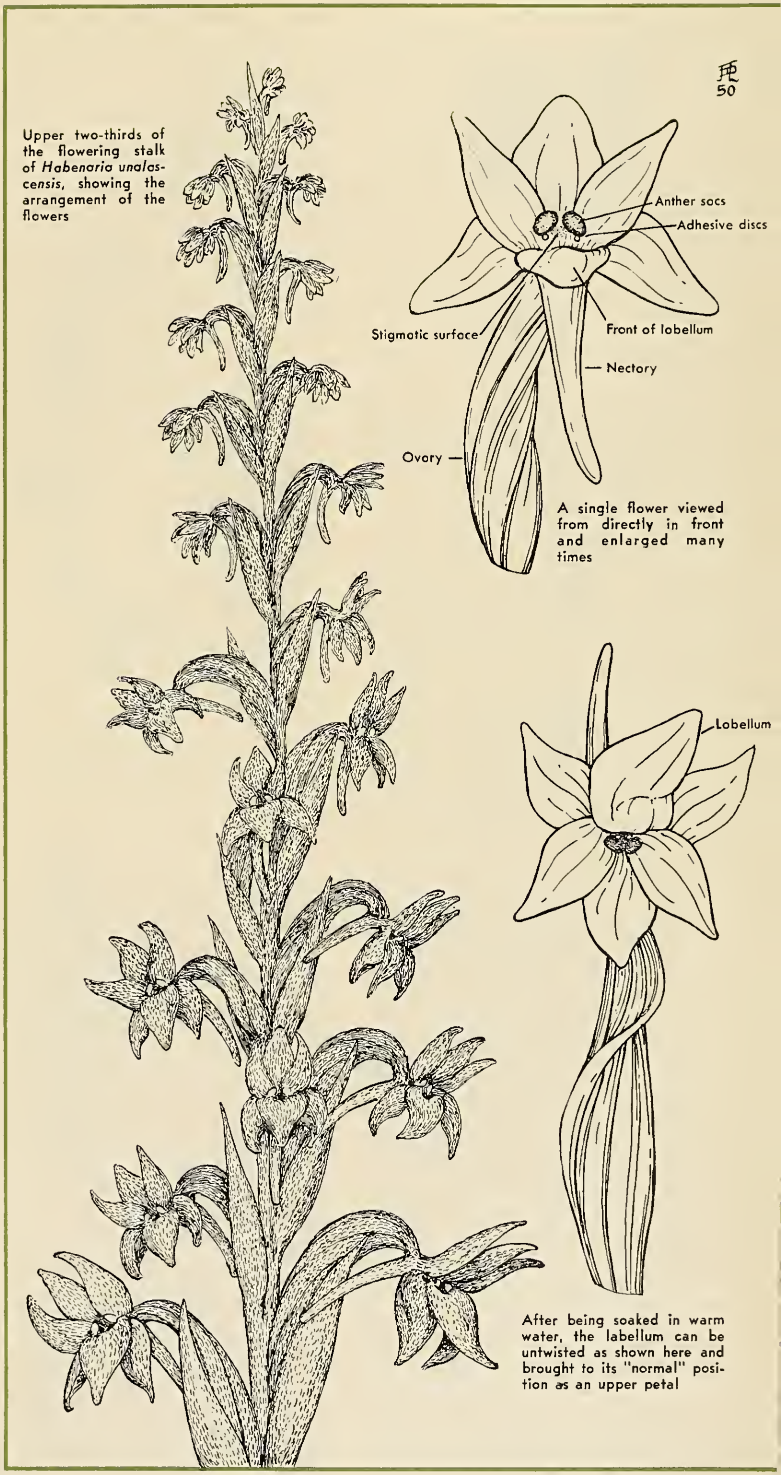
Orchids have three sepals and three petals. One petal is usually modified out of all proportion to any of the others. This petal is called the *labellum* or lip and is the most obvious of the orchid's peculiarities. In many species the labellum has been fashioned by that old firm of floral architects, "Function & Efficiency," into a highly decorative container loaded with nectar.

This *nectary* or honey-vase is displayed like an advertisement to attract insect customers—and I mean customers instead of guests, because visiting insects have to do a certain amount of work to pay for their refreshment. But I'll come back to this part of my yarn later; right now let's look a little deeper into what a flower must do before it can qualify as an orchid.

Now, the orchids are second cousins to the lilies by way of the irises; and the labellum I just mentioned is actually an upper petal that has been twisted halfway 'round—from the twelve to the six o'clock position – where it functions as a landing strip, restaurant, and signboard all combined. No imagination is needed to see where the twisting has taken place in the Habenaria flower. If you examine it through a magnifying glass, the ovary shows distinct grooves where the twisting took place. And if you will look at the drawing where I have boiled one of the flowers and untwisted it, you will notice that the labellum is now back in its original position as an upper petal. This extraordinary change in the position of the petal, accomplished by twisting, makes possible the insect pollination now to be described.

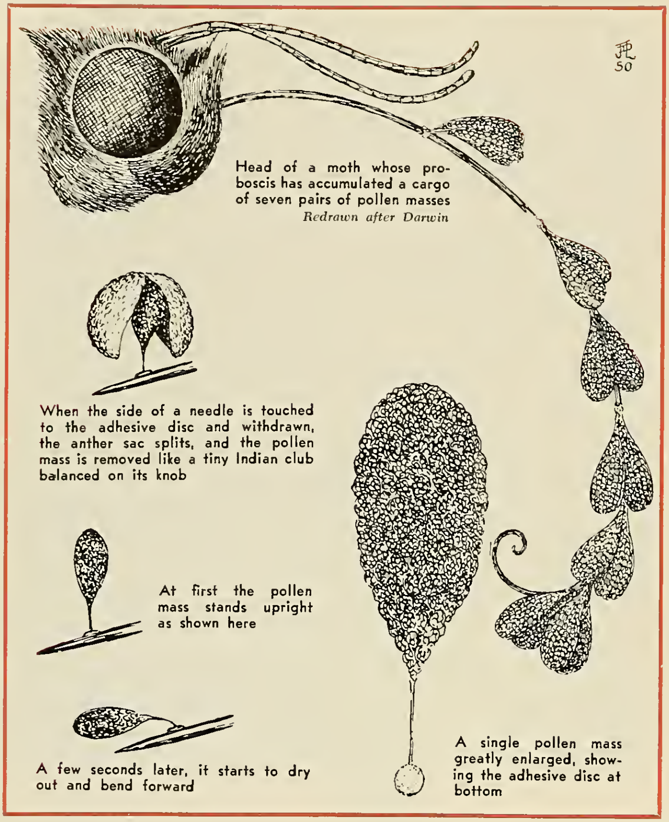
Orchids have specialized in insect pollinization, and nothing has been left to some light-minded insect's fancy. The accommodations are practically foolproof.

To gaze down a Habenaria's


Upper two-thirds of the flowering stalk of *Habenaria unalascensis*, showing the arrangement of the flowers

A single flower viewed from directly in front and enlarged many times

After being soaked in warm water, the labellum can be untwisted as shown here and brought to its "normal" position as an upper petal



Head of a moth whose proboscis has accumulated a cargo of seven pairs of pollen masses
Redrawn after Darwin

When the side of a needle is touched to the adhesive disc and withdrawn, the anther sac splits, and the pollen mass is removed like a tiny Indian club balanced on its knob

At first the pollen mass stands upright as shown here

A few seconds later, it starts to dry out and bend forward

A single pollen mass greatly enlarged, showing the adhesive disc at bottom

throat makes you feel like a Brownie's dentist. Sticking straight out at you like a tongue is the labellum. At the far end of the labellum is the opening to the nectary. Viewed from the outside, this honey-vase forms the dangling spur that reminded some Latin-conscious botanist of the checkrein to a horse's harness. Thus the orchid came to be called the rein orchis or *Habenaria,* from *habena,* meaning "throng" or "strap."

Right above the opening to the nectary—in almost exactly the same location where a normal human throat sports a set of tonsils—you will notice a pair of curious little gadgets. These are the anther sacs, all that evolution has left of the stamens. Here we have two tiny cases filled with pollen; and, unlike the majority of flowering plants, in which the anthers are fastened to the ends of the *filaments* or stamen stalks, this plant has eliminated the filaments altogether and set the anthers snugly against the back of the throat. And, to be of any use in Habenarian society, the pollen enclosed in the anther sacs has to come into contact with the stigma of another Habenaria flower.

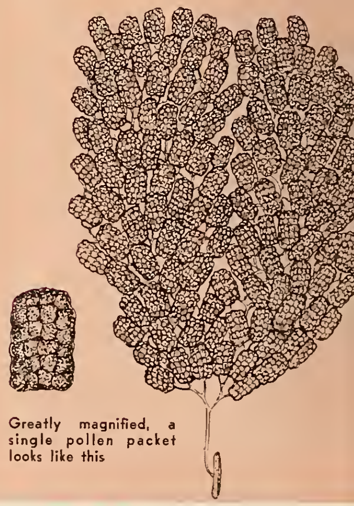
Most flowers have their stigmas in prominent positions, where they can't be overlooked by an insect that drops in for lunch. Sometimes Nature has come very close to comedy in the arrangement of the stigma. In the Iris the trick is done by a tiny, transverse lappet, the *stigmatic shelf,* set at the doorway to the stylar arcade. The stigmatic shelf scrapes off pollen from a visitor's back as neatly as a pickpocket lifts a watch. In the case of the white sage *Salvia apiana,* the style sticks way out beyond the flower where the stigma is bound to tickle the black velvet bolero of the first bee that shows up.

These two cases represent one extreme of stigma organography; the other is shown by our orchid. Here again the flower reduced the stigma to a cluster of specialized cells located just between and below the anther sacs. This is the *stigmatic surface,* and any hit by a pollen grain is successful.

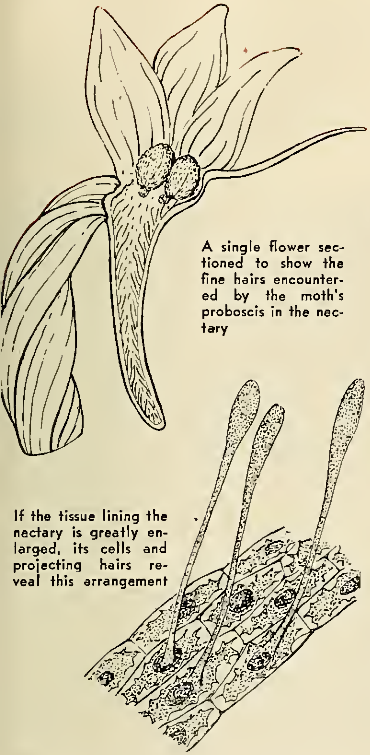
Now, flowers have developed many different systems of seeing to it that pollen reaches the stigma. In some families the wind takes care of the work; these plants throw pollen around like microscopic, yellow confetti on the chance that some of it will land where it will do some good. Some have the anthers and stigmas arranged so that if the plant fails to secure the visit of an insect, it can pollinize itself. This system is popular with some species of *Amaranthus.* Others don't take any chances at all. You find this scheme favored by the ordinary violet.

Most folks would never guess that the violet makes two sorts of flowers on the same individual: the regulation violet flower that depends upon an insect go-between, and an-

A single pollen mass further magnified and spread out to show the packets of pollen joined in clusters by waxlike strands. A single packet against a black background is barely visible to the naked eye as a tiny white speck



Greatly magnified, a single pollen packet looks like this



A single flower sectioned to show the fine hairs encountered by the moth's proboscis in the nectary

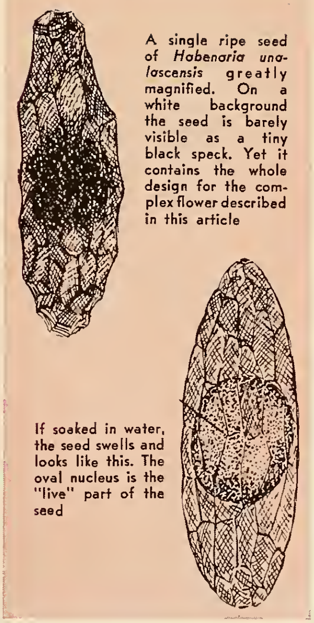
If the tissue lining the nectary is greatly enlarged, its cells and projecting hairs reveal this arrangement

other set of flowers few people ever see. These are the *cleistogamous* flowers, which, although entirely self-sufficient, produce perfectly good seed. This system is absolutely risk-free — something like wearing belt and suspenders both at the same time. Finally, the *Yucca* goes to the extreme in insect pollinization. The tiny *Pronuba* moth actually gathers the pollen with her own fair little claws, rolls it into a neat pill, waddles to the top of the stigma, and deliberately rams it into place. The entire process is almost too fantastic for belief.

With our orchid, this concurrence of functions vital to both plant and insect is as astounding as in the yucca scheme. But here the plant instead of the insect seems to take the initiative. Habenaria's pollen supply is sealed up in the anther sacs. Moreover, it comes packaged in neat little clusters tied up with microscopic threads of wax. These clusters are called the *pollinia,* and, since their operation has to be surefire, nature and evolution have so engineered things within these microscopic clusters of living cells that at the right time each pollinium will become a tiny, automatic machine.

The fact that the pollinia are scheduled to function—not at once but after the elapse of a few seconds —is just another of those profound facts that make the study of nature worth anything you may have to put into it. What I am now about to describe makes fiction seem colorless, for the actuality takes place by delayed action and the result is as certain as the operation of a timebomb. It goes like this . . .

In a flower that has not been robbed by a special species of moth, a good magnifier shows that just beneath each pollinium there is a tiny green disc. Each disc has a sticky surface. Barely touch this surface with the finest needle you can get, and the disc clings to the side of the needle with almost intelligent determination. This is the first step in a series of physical and chemical operations that are absolutely necessary for pollination to be effective.



A single ripe seed of *Habenaria unalascensis* greatly magnified. On a white background the seed is barely visible as a tiny black speck. Yet it contains the whole design for the complex flower described in this article

If soaked in water, the seed swells and looks like this. The oval nucleus is the "live" part of the seed

When you pull out the needle with the discs sticking to it, the same action causes the anther sacs to split down the sides, and the pollinia are pulled out standing upright like two microscopic Indian clubs balanced on their knobs.

Now, when the moth comes to sample the nectar, she drinks it through her proboscis—a long, hollow tube fastened to the front of her face. This proboscis is a pump and works like a soda straw. When she shoves it down into the nectary, her head and the upper part of her proboscis are certain to bump against the adhesive discs, which stick and hold fast exactly as they did on the needle. None of this pollen can possibly reach the stigmatic surface of this same flower.

When first pulled out, the pollinia stand upright exactly as they did on the needle. In this position they can't touch anything for a few seconds. It takes the moth quite a while—according to moth time scale—to finish robbing the flower, because the inside of the nectarium is lined with an unusual type of hair. This makes the moth take her time at the job, since she has to thread her proboscis carefully through the barricade before she reaches the nectar. The delay is absolutely essential, for it takes a few seconds for the cement on the adhesive disc to set firmly so that the pollinia will not be displaced in the next series of operations.

By the time the cement has set, the pollinia themselves have dried out, and as they shrink they bend over parallel with the sides of the proboscis and now point straight ahead. By this time the nectary has been thoroughly robbed. The moth pulls out her proboscis and visits a new flower. Here, contact of the pollinia with the stigmatic surface is now as inevitable as no-contact was when the pollinia stood upright. All these fine adjustments and synchronization of time, dehydration, surface tension, etc., are wonderful enough, but there is even more to the story than this.

The stigmatic surface is also adhesive but in a different way from the discs. Here the stickiness is more of the type you find on a piece of "Scotch tape"; that is, it is a sort of superficial gumminess. If this surface were either more or less adhesive than it is, the whole procession of events would collapse at this point.

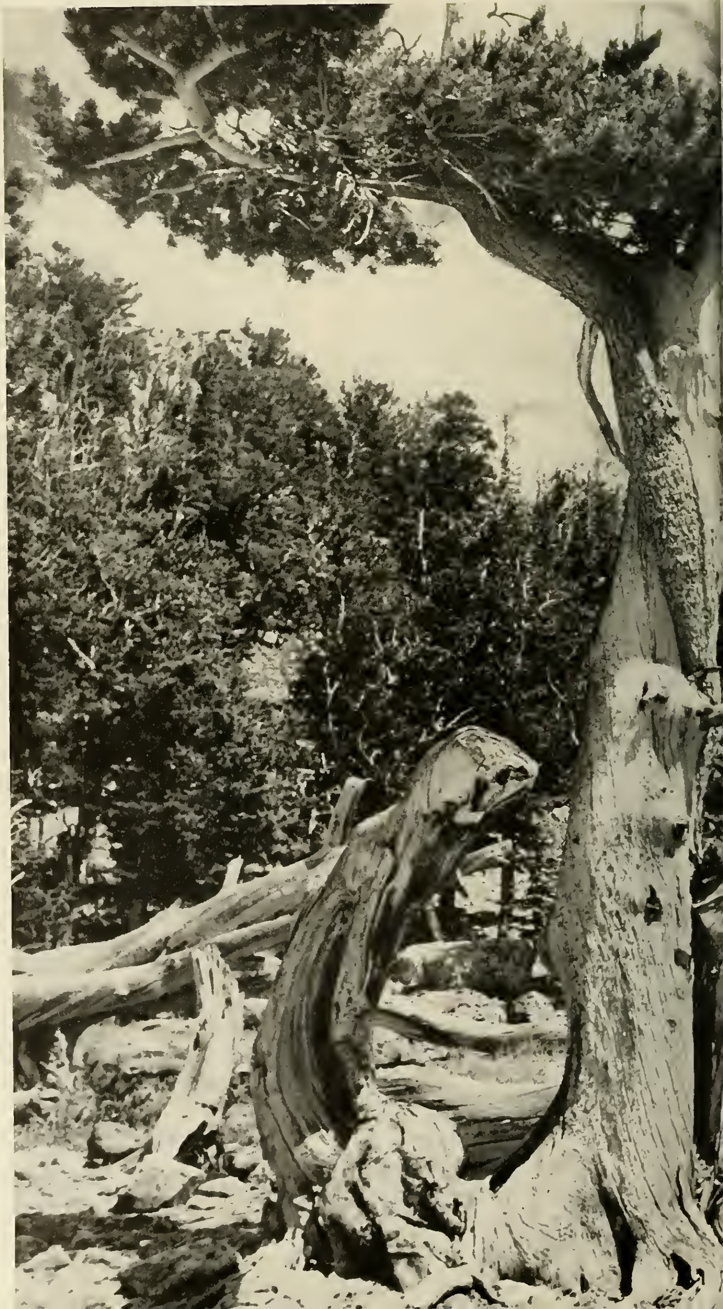
Since no single flower needs all the pollen in the pollinia, only enough grains are pulled from the cluster to ensure fertilization. This bit-by-bit donation of pollen continues with each flower visited until the supply is all gone—assuming, of course, that there are flowers enough to take it. This is the point at which the degree of adhesiveness of the stigmatic surface is of supreme importance. If it were less sticky, too few grains would cling to it; if more so, the whole pollinium would be pulled from the moth's proboscis and thousands of grains would be wasted.

All this complicated procedure is directed toward a single end: to make more seeds in order to make more orchids. When I say "more" seeds I mean exactly that. A single flower of one species has been estimated to have produced 1,856,000 seeds. Habenaria can't match this output, but if half the seeds from each plant could grow to maturity, this orchid would soon be as common as grass.

But circumstances are so balanced that such a remarkable situation can't develop. Habenaria seeds are extremely small, only about 1/200th of an inch long. Furthermore, each seed is hardly a finished product, since, unlike the seeds of most plants, Habenaria seeds have no food reserve stored up to give the embryonic orchid a start in life. This means that the seedling has to make good from the start. Unless the conditions of temperature, moisture, soil, and shelter are practically ideal, success or failure for the seedling are separated by a hairline, and it probably has one chance in a thousand. So perhaps the most astonishing part of the Habenaria story is that such an unadaptable little character ever managed to stake out a claim in the dry chaparral in the first place.

THE MYSTERY OF *Twisted*

▼ A LEFTWARD SPIRALING Engelmann's spruce near St. Mary's Glacier in Arapahoe National Forest



Trees

Photo by Cora Heddington

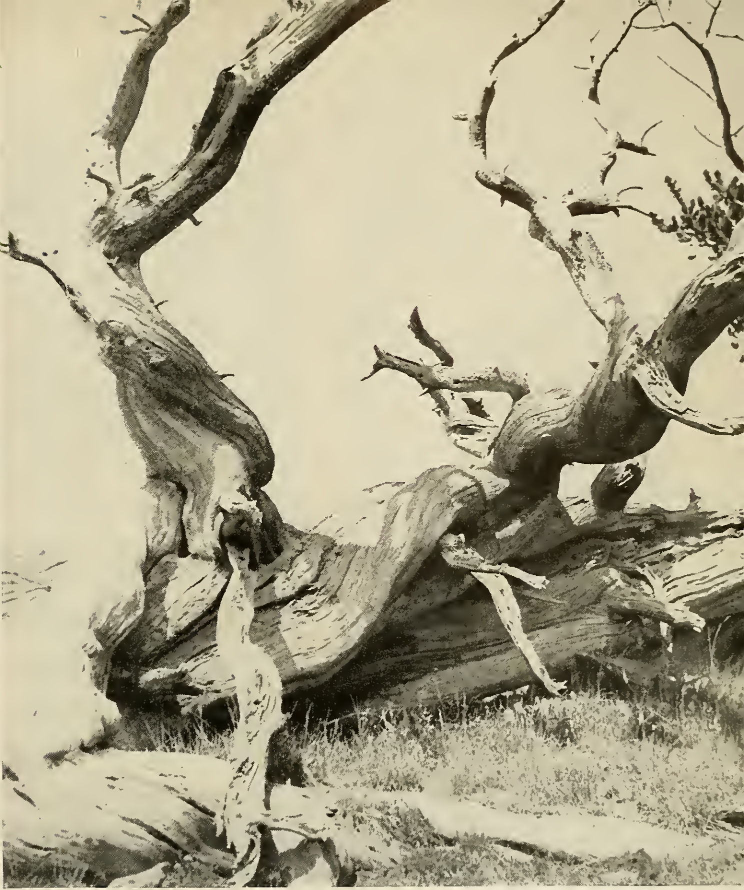


Photo by Cora Heddington

▲ **Spiral grain** is sometimes exaggerated into tortuously twisted forms like this at timber line. A tree on Mt. Evans, in Colorado

Do they reflect the spin of the earth, or the effect of strictly local influences? For centuries, people have wondered—particularly the lumberman, who is cheated by their corkscrew grain

By Paul M. Sears

THE homesteader came originally from the plains—from "treeless Texas," as he called it. Here in western New Mexico piñon pines stood around his dry-land farm in a neat open woodland. Trees were good to have about, the homesteader agreed, but these piñons were a sad disappointment. "You can't split 'em," he complained. "The grain twists around like a corkscrew. You start a clean split at one end of the log, and next minute you're hacking into it right *across* the grain. Why they have to grow that way, I don't know."

Neither does anyone else, including foresters who have tried hard to find out. The homesteader was up against a real mystery. Why do some individual trees, of many species and in many regions, grow with a truly mathematical spiral in the grain of their otherwise quite straight trunks? The question is not idle curiosity. Spiral grain, as the homesteader could testify, is usually an economic liability. More rarely, it can be an asset.

The spiraling of a stately tree trunk is beautiful in its natural geometry, but it is rarely noticed in living forests. Ordinarily only dead trees from which the bark is gone reveal the regular warp-lines winding upward around the trunk and out onto the larger limbs. In burned-over areas in the western forests, where standing, fallen, and half-recumbent dead trees await slow decay, the spiraling is so obvious that it can be measured by systematic surveys.

Thus one forester in Washington State counted 400 such trees in a sample area. All of them showed spiraled grain, making one complete turn, on the average, in about twelve feet of trunk length. More significantly, 96 per cent of them were twisted to the right. Likewise in a stand of alpine fir in Pike National Forest in Colorado, 85 per cent of the trees were twisted to the right. The gnarled apple trees in old orchards, to take another example, are spiraled almost invariably to the right.

This predominance of a rightward twist raises the interesting question of whether trees in the Southern Hemisphere might not be expected to twist mainly to the left. There are some reports that this is so; but unfortunately for the theory, the evidence in our own hemisphere is not consistent: a stand of Douglas fir in coastal Washington near sea level showed twisted grain in only 25 per cent of its individuals, and these were mostly spiraled leftward. Furthermore, among hardwoods, spiraled maples turn mostly to the right, but elms, though usually straight grained, turn predominantly to the left when they do spiral.

Thus we may be reasonably sure that spiraling is something more than a response to the pervasive forces of the earth's rotation. It seems to occur most often where stony soil or harsh climate gives the tree an uphill fight for survival.

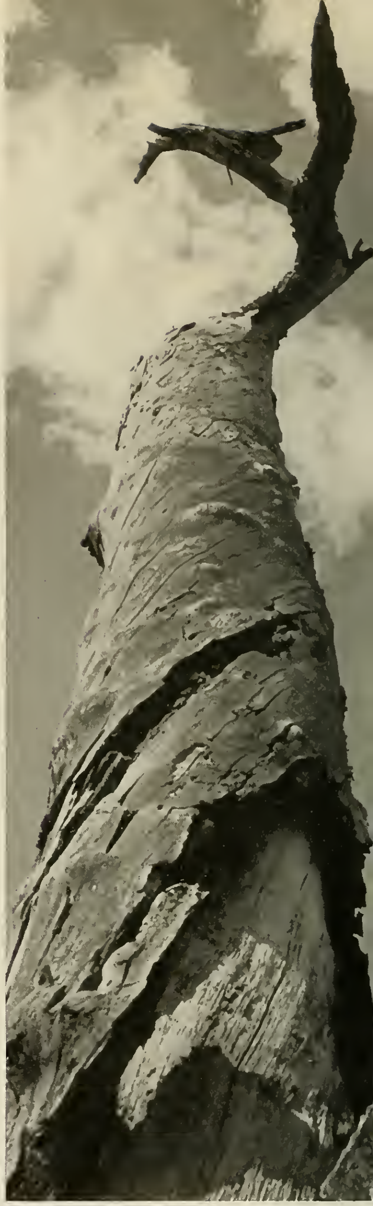


Photo by Paul M. S

▲ The standing remnant of a once-great ponderosa pine

Photo by Paul M. Sears

◄ Many a twisting tree conceals its spiraling grain until the bark falls off, as in the case of this fallen ponderosa pine trunk in the Zuni Mountains of New Mexico

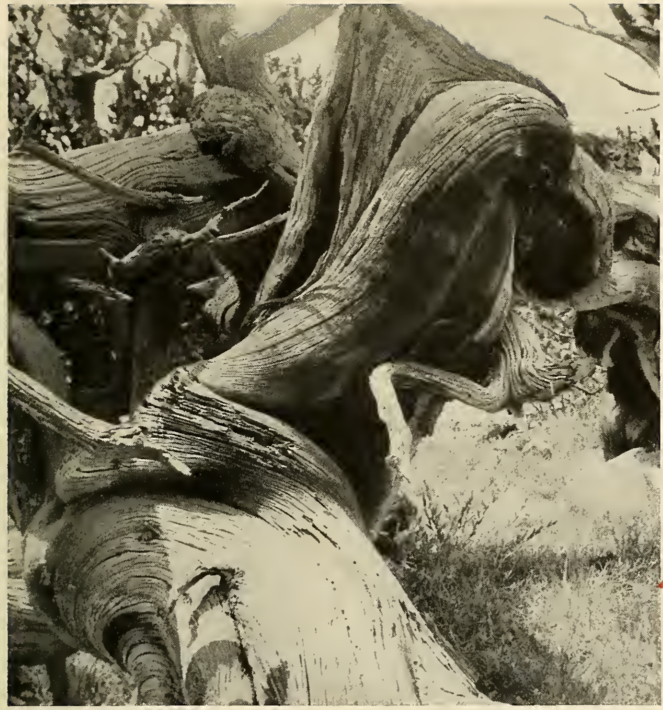


Photo by Cora Heddington

▲ THIS INTENSELY TWISTED TREE at timber line on Mt. Evans shows how complicated the spiraling can become when the branches also are involved

Single trees growing in exposed sites are generally more "tightly wound" than protected individuals growing in near-by forests. Spiraling, once started, grows more intense as the tree grows older.

The contorted tree-forms at timber line in the Rockies are intensely though irregularly spiraled. Not too far below timber line the high altitude forests are composed of trees with fine straight trunks, and here nearly every tree in some stands may be neatly spiraled. Certain high altitude species, such as Engelmann's spruce and limber pine, are noted among foresters for their consistent spiraling.

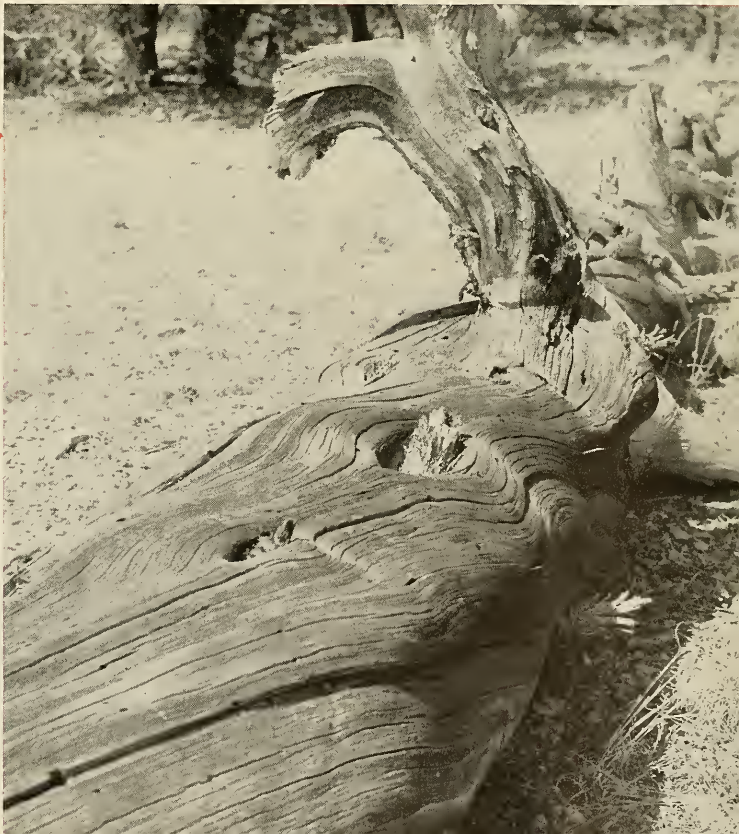
However, altitude alone does not control spiraling, for stands of Arizona cypress in the Coconino National Forest at an elevation of 4000 feet are as deeply twisted as spruce trees growing at three times that altitude. The twisting of Arizona cypress is often evident in the living tree, where the trunk may be fluted into ridges that twine upward around one another like compound candelabra stems.

The tendency to spiral seems to be partly hereditary. A few extreme cases are definite: for example, Scotch pine seedlings imported from northern Europe grow into useful trees in the United States, but seedlings of the same species from a locality in south Germany produce corkscrew-like trees—freak forms in which twisting affects the straightness of the trunk as well as the grain. Here, two hereditary races of Scotch pine clearly exist.

Because of suspected hereditary factors, foresters in charge of re-

▼ KNOTHOLES interrupt the regularity of the spiraling grain in this ponderosa pine

Photo by Paul M. Sears



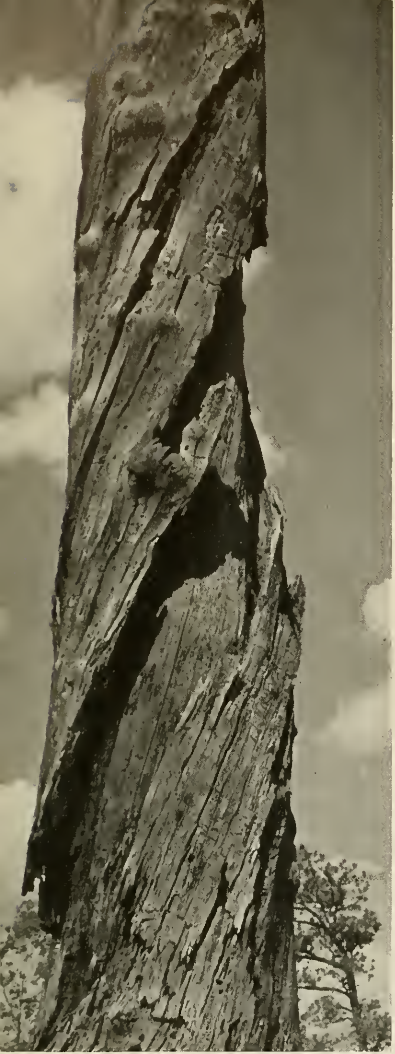


Photo by Paul M. Sears

▲ THIS TREE, 24 inches in diameter at the ground, made a complete turn in 12 feet of trunk length. Where the sapwood has partly decayed, the heartwood shows that the tree spiraled less rapidly when younger. A ponderosa pine one-half mile west of the Continental Divide in the Zuni Mountains of New Mexico

seeding projects try to select seed only from unspiraled trees. This may require cutting into the inner bark of the living seed tree to determine the direction of grain, although in some species, such as Douglas fir, spiraling is often suggested by the trend of the outer bark-ridges.

The desire to propagate straight-grained trees is born of the troubles that spiral grain inflicts on those who would use the timber. Lumber from trees with spiral grain, quite understandably, tends to warp as it seasons. And for structural uses spiraled timber is weaker than straight-grained timber. The degree of weakness depends on the tightness of the spiral; in extreme cases the grain may make a full revolution in as little as two feet of trunk length. One inch of deviation in twenty inches of trunk length is objectionable in structural work, and much more may be disastrous.

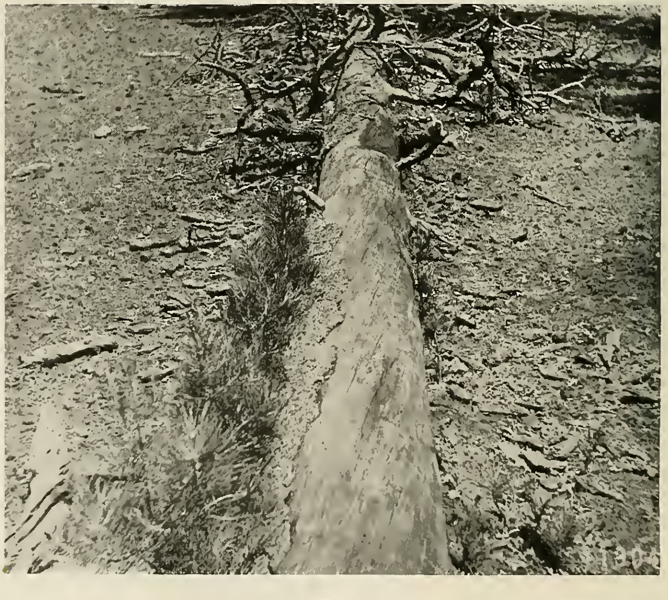
Spiraled timber may also split or shatter to pieces in machining operations; Douglas fir and hemlock are particularly bad in this respect. Further disadvantages occur when a long plank from a spiraled tree is planed. Some roughness in the finished board is inevitable, because no matter how the plank is cut, some of its surface will lie across the grain. Fortunately, the softer woods such as ponderosa pine stand sawing and planing quite well in spite of twisted grain, and furnish lumber that can be used wherever strength is not required.

Commercial lumbermen are not the only sufferers from spiral grain effects. The Indians living near Lake Kahnipiminanikok, in Ontario, make their canoe paddles from cedar. The grain must be straight to serve this purpose, and though abundant stands of cedar are available, the trees are nearly all of twisted grain.

It is good to report, by contrast, that occasionally spiral grain has been a providential blessing to man. Notably, the rural plowmakers of colonial America needed, and eagerly sought, the rare hardwood trees of the eastern forests that had a leftward-twisted grain. Such timber accommodated itself naturally to the shape of the moldboard. The tighter the spiral the happier was the plowmaker, for then the plow would not be weakened by cross-grain cutting needed to finish the close curve of a moldboard.

The ultimate complexity of spiral grain appears in some of the tropical hardwoods such as mahogany, which exhibits an "interlocking"

U. S. Forest Service photo



➤ WHEN CLOTHED in bark, it might have looked like a good timber tree. Recumbent, its greatest service is as "nursemaid" to the row of seedlings springing up along one side grain. Here the direction of spiral is varied from right to left several times during the life of the tree. Such timber is difficult to work, but the effort is rewarding, for these are the exotic woods of the fine cabinetmakers, who prize in their finished pieces the beautiful figure of grain resulting from the alternating spiral.

Many of the strongest and toughest timbers of tropical Australia are heavily interlocked in grain. The karsi *(Eucalyptus diversicolor)* may grow with either straight or interlocking grain, the latter structure producing stronger timber. The maple silkwood of Queensland, when milled, produces a light brown to pink lumber, and the grain may be wavy or curly but is most often interlocking. This jungle tree is one of the best cabinet woods of the world and is a favorite among Australian furniture makers. The grain of some of these tropical Australian woods may interlock at nearly 90 degrees in extreme cases.

Fortunately, you don't have to visit a remote and ruined forest to observe spiral grain; some of the telephone poles in your vicinity are likely to show spiraling. And if you burn seasoned logs in your fireplace, pull the bark away from a few of them. You may uncover a section of one of Nature's barber poles.

THE DESCENT INTO THE BARRANCA DEL COBRE

Continued from page 445

We moved forward once more on the twelfth, following the torrent, although there appeared no possible way it could pierce the mountain wall ahead. Suddenly the stream turned and dashed at a huge rock, which blocked the view of the mountains beyond. It swung to the right and around the base of the rock. We followed. At the moment of turning, my mule reared backward. And no wonder! Instead of a mountain climb ahead, we were standing on the dizzy edge of a huge canyon, right across our course!

The torrent plunged straight downward into a series of waterfalls for 1500 feet. It was now a raging cataract which roared down the cliff, while the flung spume drifted into the gulf below, a thousand tiny rainbows riding on its spray. The dim trail zigzagged down the hazardous slope, which seemed unnegotiable for mules.

Juan said that the canyon, the Arroyo Hondo, extended miles to the right and left and there was no trail to get around it. We must get across it, and the Barranca was still four days away. Both Paul and Tommy were feeling much better, however, and voted to proceed. I sent Jim and Juan part way down the "zigzag" to see if it were negotiable, for there might be no turning back, with 20 animals.

Jim reported it to be dangerous with uncertain footing, but he thought we might make it. Also, we could turn around at one point. So down we went, our animals sliding most of the way, with the ever-present danger of starting an avalanche. It was a happy moment when we reached the bottom. Since we had started at sunrise, it was now only about 10:30 in the morning, and we paused for a bite to eat. Juan claimed there was a poisonous plant in the stream which would kill the animals, so we hobbled them.

The floor of the canyon was flat like the Yosemite, ½ mile wide, and covered with a magnificent primitive forest of pines, firs, and cedars, untouched by ax or machete. Some of them were 6 feet in diameter and 150 feet in height. Deciduous trees resembling beeches, alders, and even maples appeared in scattered clumps. On the north side the walls were sheer cliffs and ledges, very different from the south slope we had descended. I later found debris from floods at the mouths of caves 50 feet above the normal level of the river; so Jim was correct in his estimation of the terrific power of flash storms in this region. In bushes below the caves I collected a thrush with a bright orange lower bill. It became the type specimen of the Olive-winged Nightingale Thrush[3] which I later described as new to science.

That night, I was awakened by a hoarse, breathy sound, which startled me into thinking a jaguar was preparing to leap. Whirling our giant collecting flashlight on the trees at the base of the cliff, I could locate no animal. Later I was aroused again by a frightening bedlam of growls, coughs, and shrieks such as I had never before heard, emanating from the top of the cliff. It awoke Tom, and he called that it was a large owl! During the following year the type specimen and two other examples of a very rare Stygian Owl were secured by my collector, Chester C. Lamb, in this same mountain range 100 miles to the south.[4] A few months later at the United States National Museum, I imitated its calls to Dr. J. H. Riley and was assured by him that they must have come from a Stygian Owl, as he had heard the same queer sounds from its nearest relative, the Santo Domingo Stygian.

As it was still early afternoon, I decided to essay the climb out of the canyon to Guayachi, where Juan assured us we could obtain tortillas for our *cargadores*. They were growing increasingly surly because we could not produce fresh ones every morning. We soon found ourselves puzzled by a maze of forking canyons. Even Juan lost his way and caused us to retrace our steps, with the loss of two hours time. I did not blame him, for in many places all traces of a trail had been washed away by floods. We finally emerged on a plain covered with pines, where we were assaulted by a truly magnificent thunderstorm that stung us like hail for two hours. Soon ponchos were leaking, and even the mules flinched at the terrific beating. We were glad to reach Guayachi, a small Tarahumare farmhouse in the middle of plowed ground. Cold from the icy ponchos, we hovered over a wood fire on the dirt floor.

The rain ceased, and an ancient Tarahumare told a story of many *guiculos* (wild turkeys) behind the mountain to the east. His offer to prove it at once meant that the day had just begun for me. Never was I so deceived by the deep furrows of an Indian's face. Judging he was at least seventy-five years of age, I imagined I would have no difficulty keeping pace with him, but the Tarahumares are noted for their stamina.[5] He gave me the severest "hike" I ever experienced. It was actually a continuous dog-trot without letup for two and a half hours—down hillsides, over small slippery rocks, or up shalelike slopes covered with treacherous pine needles. If I begged him to halt so I could recover my breath, he would grunt and go all the faster. He wore crude leather *zapatos* tied with deer thongs between his toes. Clearly he despised me! With tongue hanging out of my mouth and heart thumping, I missed a magnificent cock turkey but made a flopping mass of feathers of a female. As I put in a new cartridge, she got on her feet, however, and ran down the hill at great speed. The ancient guide never moved. Obviously he was afraid to run down that slippery hill on his *zapatos!* I decided to take the chance and leaped down at full speed, and I finally secured the turkey. When I returned with her, the Tarahumare let out a curious cry and flung himself into a gnomelike clog dance. Then he rushed up and patted me on the back with many grunts of approval. Evidently I had redeemed myself. But I had an additional reason for excitement. That turkey was another bird new to science! It is now the type specimen of *Meleagris gallopavo onusta*.[6] Heavy rain made us thankful we had raised a tent over our supplies that night.

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[3] *Catharus aurantiirostris aenpennis* Moore (Proc. Biol. Soc. Wash., vol. 50, p. 96).

[4] The author described the new race, *Asio stygius lambi,* in the Proc. Biol. Soc. Wash., vol 50, p. 103.

On the thirteenth, in spite of a threatening thunderstorm, we decided to move on to Chiricahui, from where we might reach the Barranca del Cobre in one long day's safari.

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[5] See "The Tarahumaras — Twentieth-Century Cave Dwellers" by George McClellan Bradt, in NATURAL HISTORY for November, 1948.

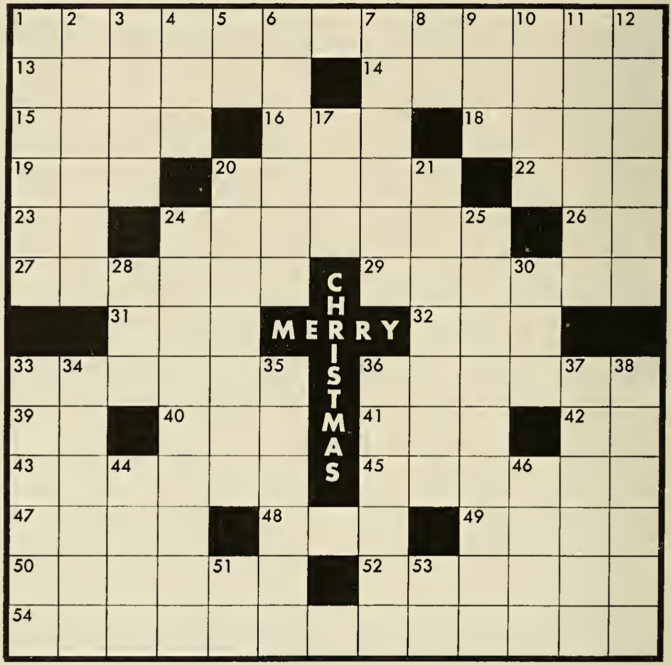
[6] *Auk*, vol. 55, Jan., 1938, p. 112.

(The remainder of the story of the descent into the Barranca del Cobre will be published in the next issue of NATURAL HISTORY.*)*

Nature Crossword Puzzle

BY ALFRED I. TOOKE

Sharpen up your wits, polish up your brains
And get out your dictionary;
Though some of the words are easy to guess,
Some are quite the contrary.



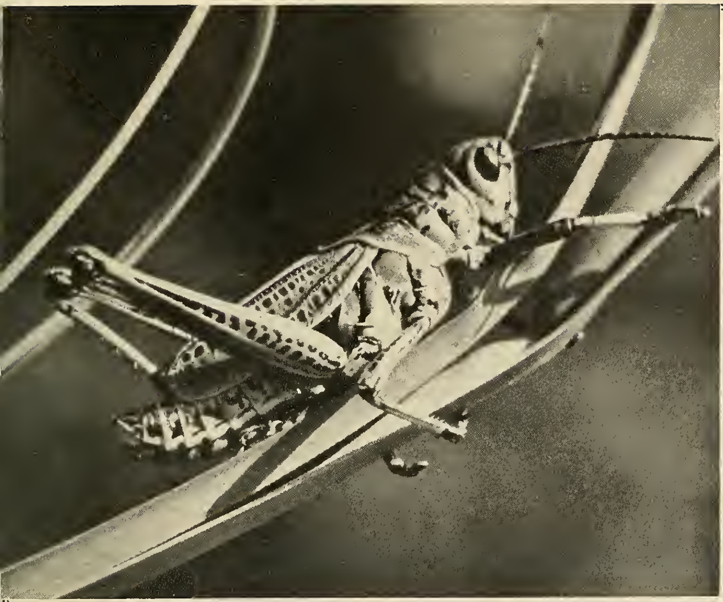
ACROSS:

1. Reptile expert.
13. Rabbit-sized rodent of tropical America (*Dasyprocta*).
14. Inflame with love; charm; captivate.
15. First stomach of a fowl; the craw.
16. Man's best animal friend.
18. Agile, active.
19. Carrion.
20. Any tree or shrub of the genus *Alnus*.
22. The iris.
23. Lieutenant (abbr.).
24. Combed and trimmed with the beak.
26. Missouri (abbr.).
27. A valuable domestic animal found wandering from its owner.
29. One of the Doric race.
31. Member of the Women's Army Corps.
32. Floating water-lily leaf; cushion on cat's foot.
33. A bell jar to protect a plant.
36. To request with authority.
39. Railway (abbr.).
40. Very small bird; also small horse.
41. Suffix used in Latin or Latinized names of groups of animals.
42. Each (abbr.).
43. Something unjudged or undecided (Obs.).
45. Pertaining to the stars.
47. Bluish-white metal in common use.
48. Kind of dirt frogs like.
49. Ninth letter Greek alphabet.
50. Endow with a halo.
52. Time rabbits lay fancy eggs!
54. Instruments for measuring declination of magnetic needle.

DOWN:

1. The neck plumage of the domestic fowl.
2. A heron with white plumage.
3. Part of tree or plant underground.
4. Baby dog.
5. Diminutive suffix.
6. A wren.
7. A fable or myth.
8. Upon.
9. Neither a solid nor a liquid.
10. Mischievous children.
11. A mass of carpels forming a compound pistil.
12. A sting ray.
17. Short poem or song.
20. Genus of food plants that ripen their fruit underground, like the peanut.
21. Opens again.
24. Capable of active use.
25. Playwright.
28. Twice the number of eggs a passenger pigeon always laid.
30. Zoology suffix terminating names of animal groups; also girl's name.
33. Driven insane.
34. Chemical compound derived from boxthorn.
35. Original word root or primitive word.
36. Crown.
37. Tidier.
38. Polish thalers.
44. Royal Naval Hospital Corps (abbr.).
46. Repetition as a method of memorizing.
51. This number written in Roman style.
53. First two vowels.

Solution on page 476



Harrison M. Reed, Jr. photo

◄ AN ADULT LUBBER LOCUST, which uses its wings for talking instead of flying

The Lubber Locust

It is probably the largest member of the grasshopper family in America

By HARRISON M. REED, JR.

THE Lubber Locust, *Rhomalea microptera,* is a pest that farm and home gardeners alike must contend with clear across the southern states and as far west as the Texas border.

Females have a body length of about three inches. With legs and antennae extended, they might measure four and one-half inches. The females seem to outnumber their consorts in a ratio of five to one.

Lubber locusts are often seen walking with an amusing but stately gait across our southern highways during the warmer months, leaving one field of destruction to conquer newer territories. Having a ravenous appetite, they cut their way through the tender parts of plant life, leaving the injured remains behind them, for they are ever on the move. Not content to remain and eat one plant, these giant insects can lay low the choicest row of your garden in a single day. However, there are other grasshoppers that are worse.

Although the lubber locust has wings, it cannot use them for flight, for they are inadequate to support the insect's weight. But nature has given them another use, that of sending and answering the mating call. Under the hard, plastic-like wing cover is a delicately colored pink and red wing that is part of a sound system. The familiar "chit-chit-chit-chit" of a summer day throughout the southland should move the garden and flower lover to search out its origin at once and kill the insect. The male calls in a higher key than the female, because his wings are shorter. The insects hear each other as much as several hundred yards apart and head toward each other, eating ravenously as they go. The lubber locust also makes a hissing sound, by forcing air from the large stigmata near the base of the wings.

The male and female have similar markings and colorings, but the male is much less brilliant. The female is buff-yellow with black markings, and her head, cape, and wing covers are bright red filled in with sunset orange-yellow. Many, however, are nearly black, particularly those north of Florida.

The female lays several batches of eggs in a season, placing them just beneath the surface of the ground, usually in sandy loam, beside some plant that will afford the young their first food the following spring. The eggs are yellow and about the size of large grains of cooked rice.

The young, ranging from 25 to about 60 in a single colony, emerge as tiny black grasshoppers with a bright yellow stripe extending from their cape to the tail end. They display a very interesting habit in their gregarious inclination to move as a body. At dusk, they will be seen to climb the nearest grass blade or weed to roost, all facing upward. Then at daybreak, before it is quite light, they turn in unison and walk down the stem to begin their day's wanderings. At this stage, early in the morning, it is quite easy to tap them off into a pan of kerosene. The wary gardener will save himself much grief if he does this for several mornings, until most, if not all, of the insects have been destroyed.

Under favorable climatic conditions the lubber locust has been known to reach plague proportions. Anyone who has observed one at work gains some idea of what an army of them could do. So, if you love flowers or want to protect the vegetables in your own or your neighbor's garden, kill the lubber locust. He is no friend.

BOOKS

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There are also 65 smaller, frequently charming sketches of birds, flowers, mammals, and frogs.

More than any other contemporary painter of birds, Menaboni has been influenced by Audubon. The same love of birds in action is evident in the work of both. Menaboni has avoided the excesses occasionally to be found in the paintings of his predecessor but in doing so has allowed his own style to become a bit too facile and polished. His birds have not a feather ruffled; their wing quills in flight stand revealed in the minutest detail, as though caught by the eye of a superspeed camera, not by the human eye. Sleekness becomes a dove, but not an eagle. But this is a comparatively minor fault. Menaboni has a fine eye for composition, and many of his arrangements of small birds among foliage are very beautiful.

The text, which runs to 75,000 words or more, tells in somewhat rambling fashion of the experiences of the Menabonis with birds and of the many pets they have kept as models for paintings. This narrative would have profited by condensation and revision. There is also a short biography of the artist and his wife by "J. S.," who is apparently an official of the publishing firm.

Menaboni's Birds will make a handsome addition to any home library. The great cost of manufacturing colored plates in this country today made its high price inevitable.

Dean Amadon

Solution to
Nature Crossword Puzzle

H	E	R	P	E	T	O	L	O	G	I	S	T
A	G	O	U	T	I	■	E	N	A	M	O	R
C	R	O	P	■	D	O	G	■	S	P	R	Y
K	E	T	■	A	L	D	E	R	■	S	E	G
L	T	■	P	R	E	E	N	E	D	■	M	O
E	S	T	R	A	Y	■	D	O	R	I	A	N
■	■	W	A	C	■	■	■	P	A	D	■	■
C	L	O	C	H	E	■	D	E	M	A	N	D
R	Y	■	T	I	T	■	I	N	A	■	E	A
A	C	R	I	S	Y	■	A	S	T	R	A	L
Z	I	N	C	■	M	U	D	■	I	O	T	A
E	N	H	A	L	O	■	E	A	S	T	E	R
D	E	C	L	I	N	O	M	E	T	E	R	S

LETTERS

Continued from page 434

ican Museum's Department of Animal Behavior:

Wild birds are not likely to lay unfertilized eggs. Egg production is controlled primarily through the activities of the ovary and indirectly by hormones secreted by the pituitary gland. The functioning of the pituitary gland depends to a considerable extent upon various climatic conditions and, secondly, upon a series of behavioral acts commonly known as courtship. During the courtship period females are generally mated and inseminated. Later, when eggs are produced by the ovaries, sperm await them in the oviduct and the eggs are fertilized. If the courtship process is interrupted to the extent that the birds are not inseminated, then it is likely that the ovaries will not be sufficiently activated to produce eggs. Moreover, as soon as a clutch of eggs is laid, the female begins to incubate them, and she becomes broody. This broody condition inhibits further egg production by the ovary. To maintain egg production, as all poultry breeders are aware, the eggs must be collected regularly. Among certain species of wild birds, prolongation of egg production has been induced by removing the eggs as soon as they are laid. For example, a flicker was induced to lay 71 eggs in 73 days. Since the sperm are not likely to remain viable for this length of time, it may be possible to obtain infertile eggs in this manner.

During the process of the domestication of the fowl, breeds have gradually been developed that require less and less courtship behavior to stimulate ovarian activity. Among present-day fowl, a rooster is not necessary to build up or maintain egg production in the hens, and the latter will continue to lay even in complete isolation. In former years it was of definite advantage to the poultryman to be in possession of broody strains because of their ability to incubate a large number of eggs. Now, with the advent of mechanical incubators and chick-rearing devices, this maternal behavior is not only superfluous but a clear disadvantage, since egg production is temporarily suspended. By vigorous selection practices, broodiness has been all but eliminated in the white leghorn.

Fishing with Lights

Sirs:

The discussion on catching fish by artificial light in the October issue of Natural History brings to mind what I observed in Algeciras, Spain, last spring.

The accompanying picture shows the fishing boats that fish in the straits of Gibraltar every night. You will notice that each is fitted with a battery of powerful gasoline lights. I was told that for a considerable period of time, this has been the only means by which successful fishing in the straits could be carried on.

While on the subject of fishing, I noticed an oversized tug equipped with a harpoon gun in the bow, and was told that the straits furnished good whale hunting.

Ottumwa, Ia. George M. Foster

Corrections

The two captions referring to a shrew and a field mouse at the bottom of pages 400 and 401 in the November issue were inadvertently transposed.

In a letter in last month's issue, Mr. J. M. Hollister told how a fish had been taken off the hook by an owl. Between the time when the story left Mr. Hollister's honest care and when it appeared in print, the fish mysteriously grew from ten inches to ten pounds!